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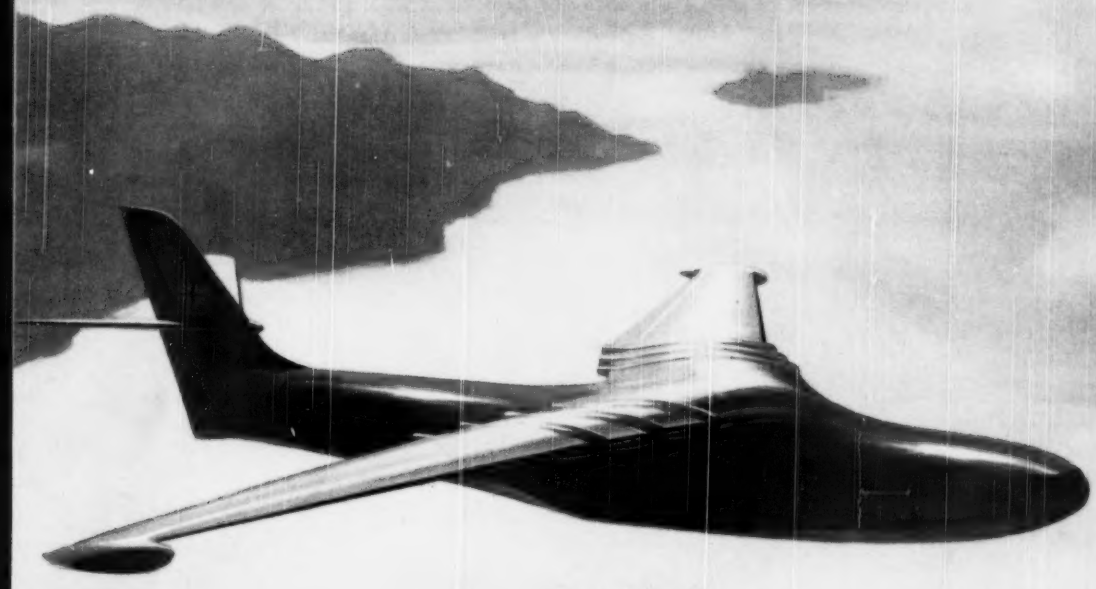

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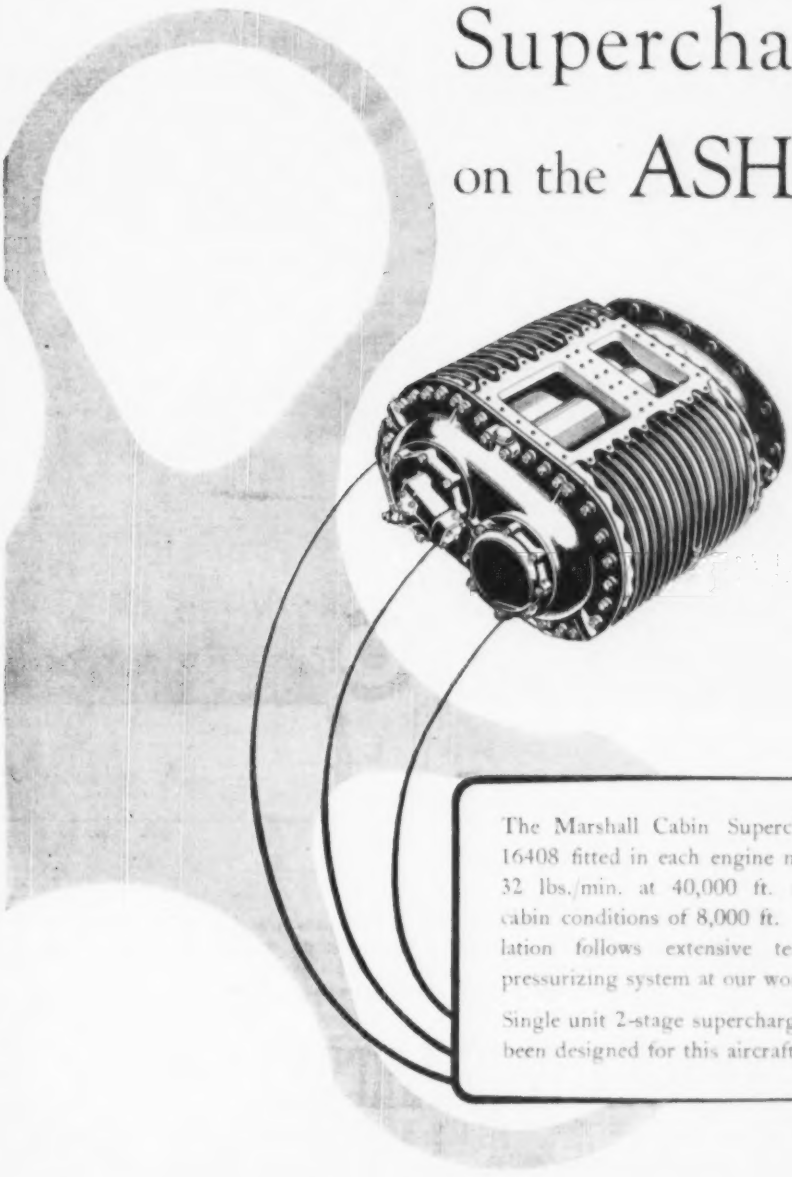

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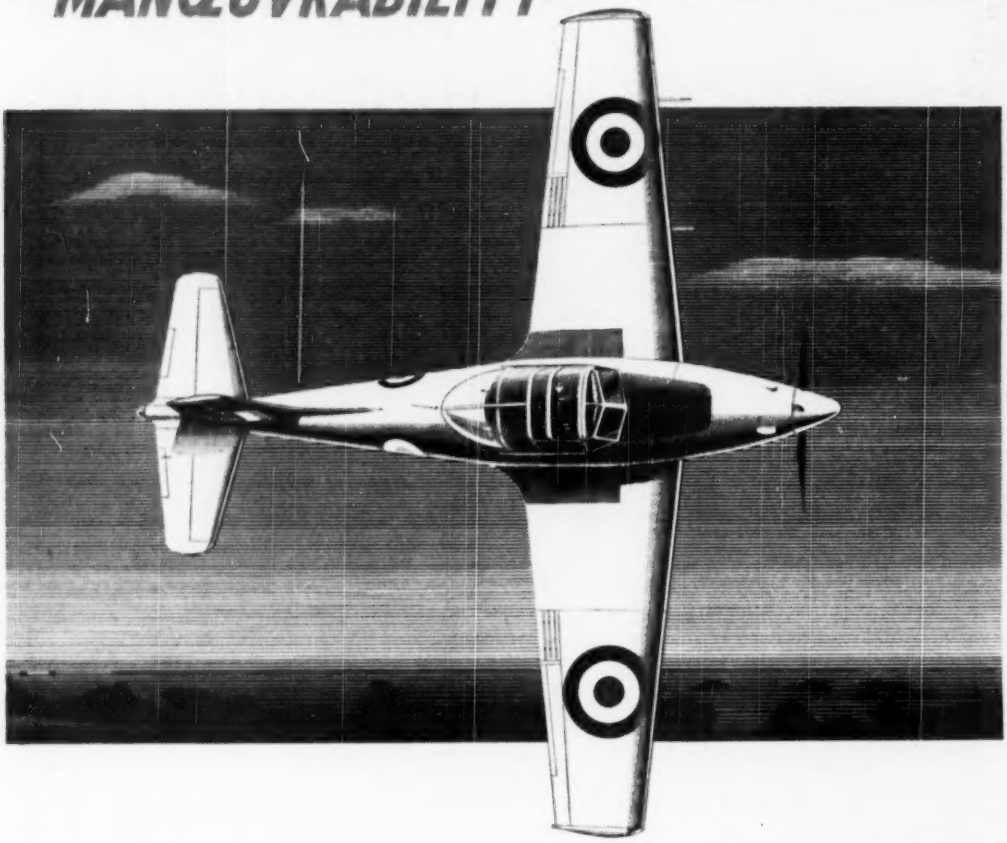

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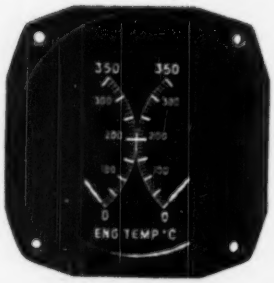

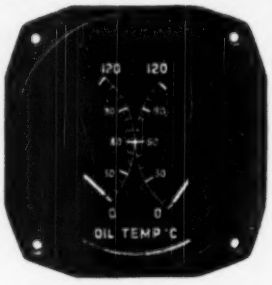

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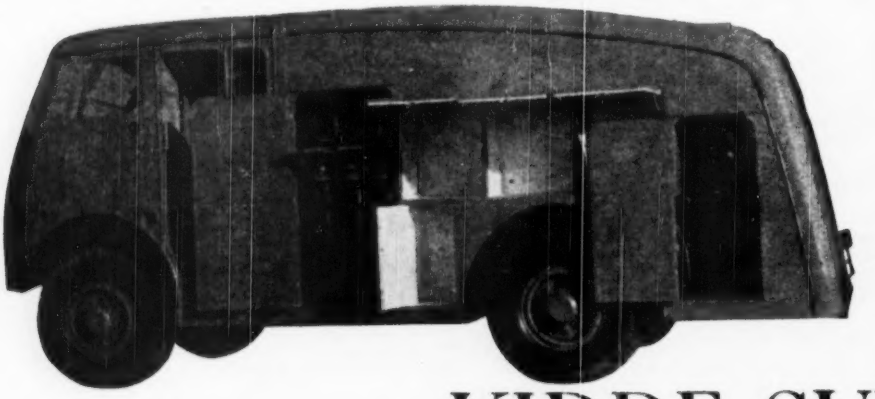

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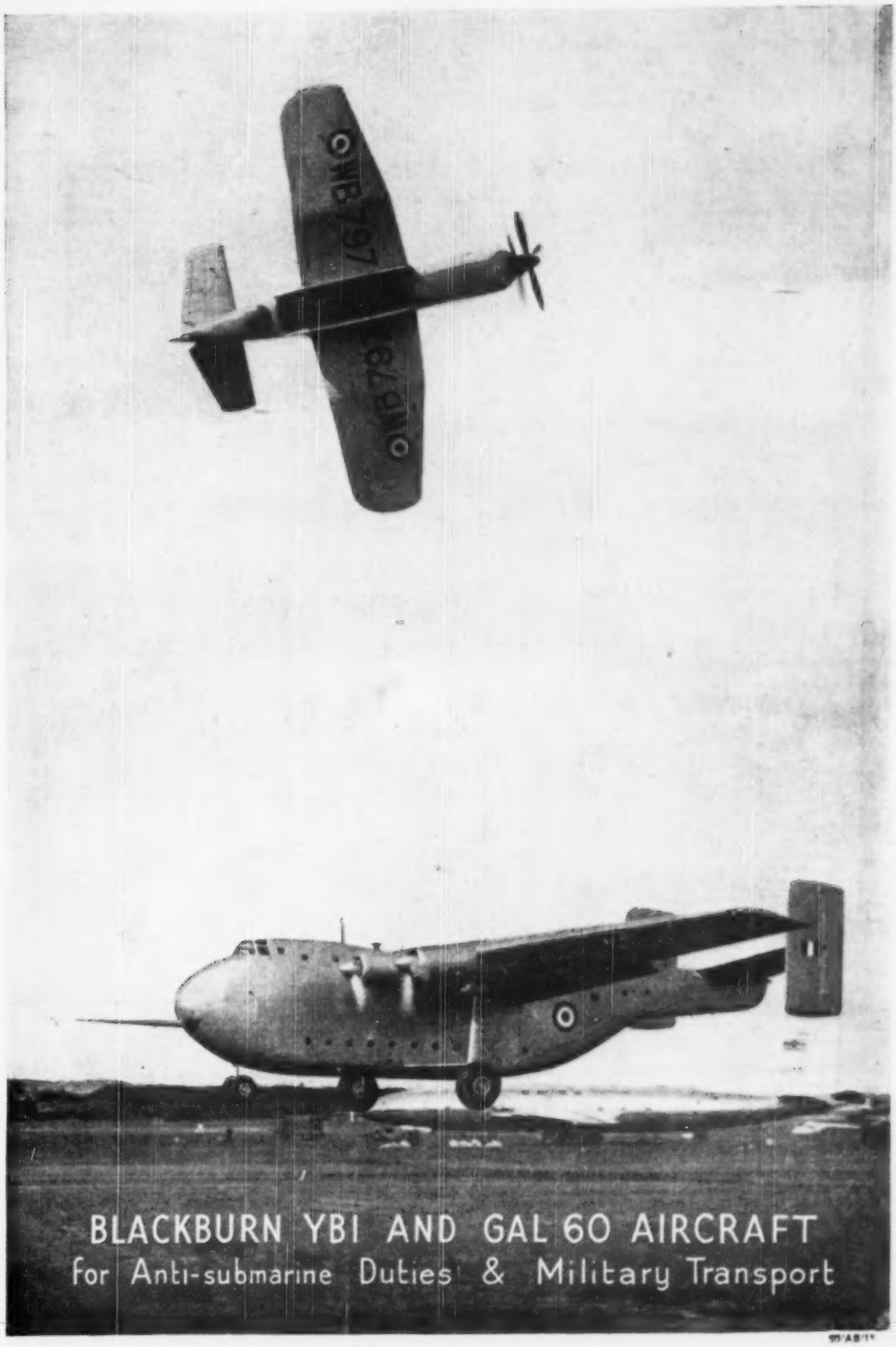
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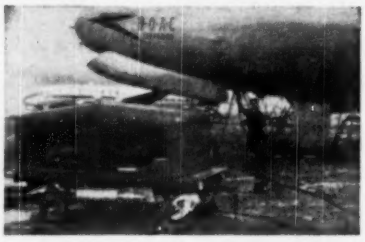

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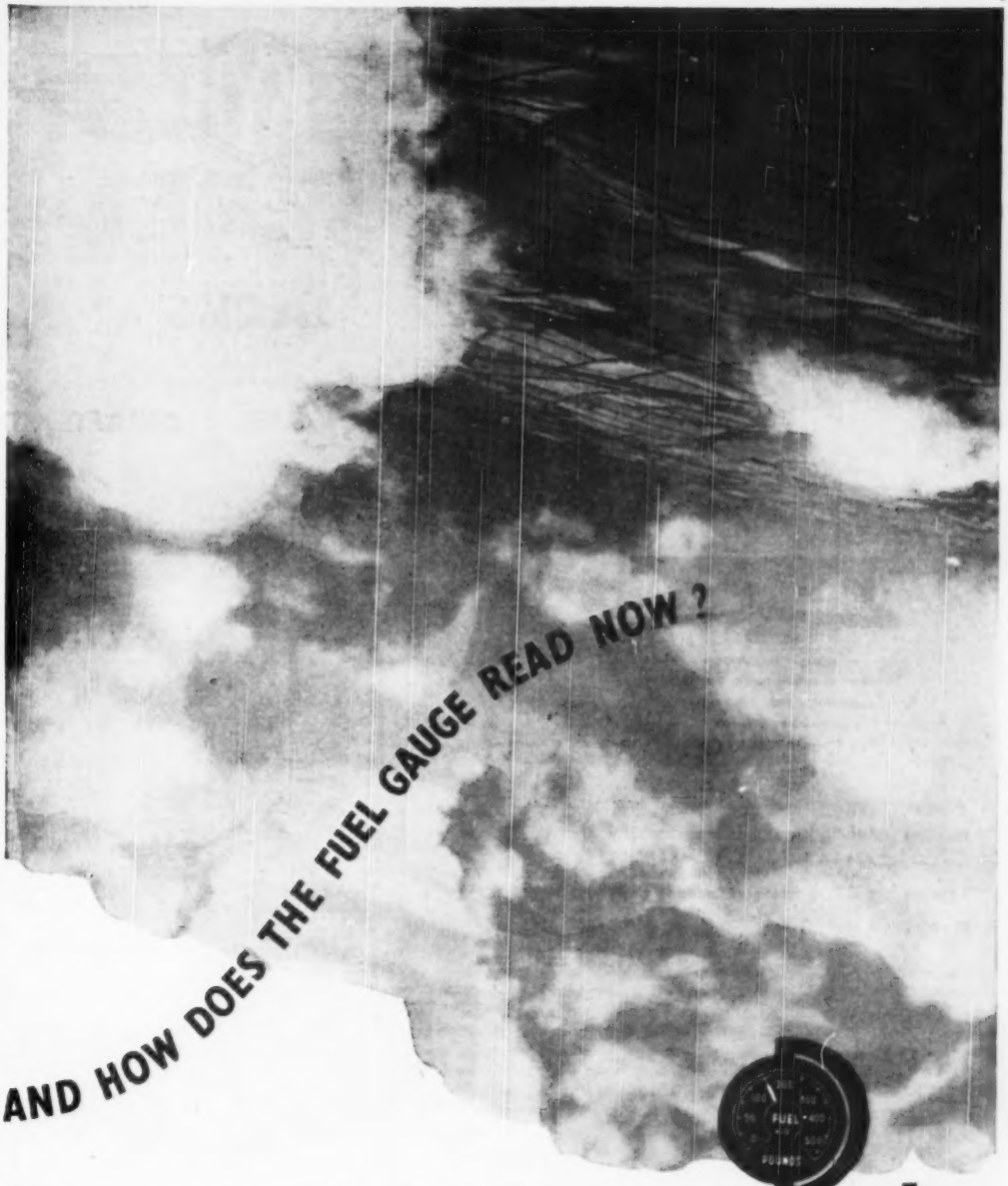

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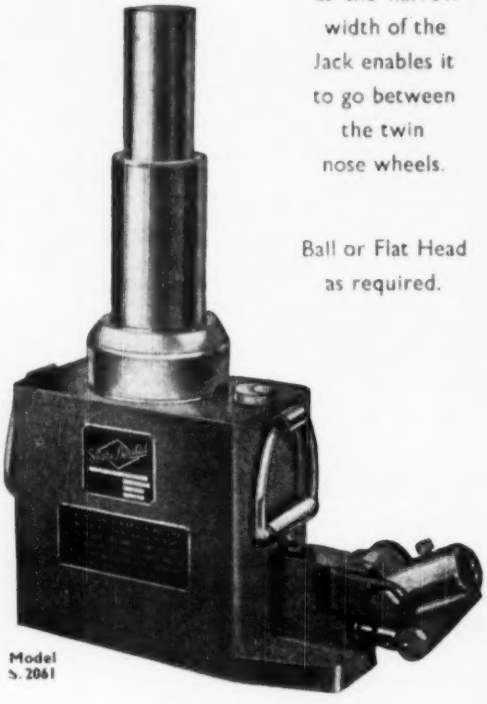

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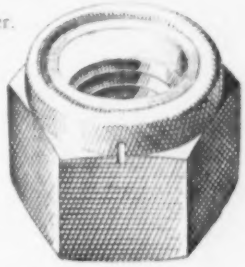

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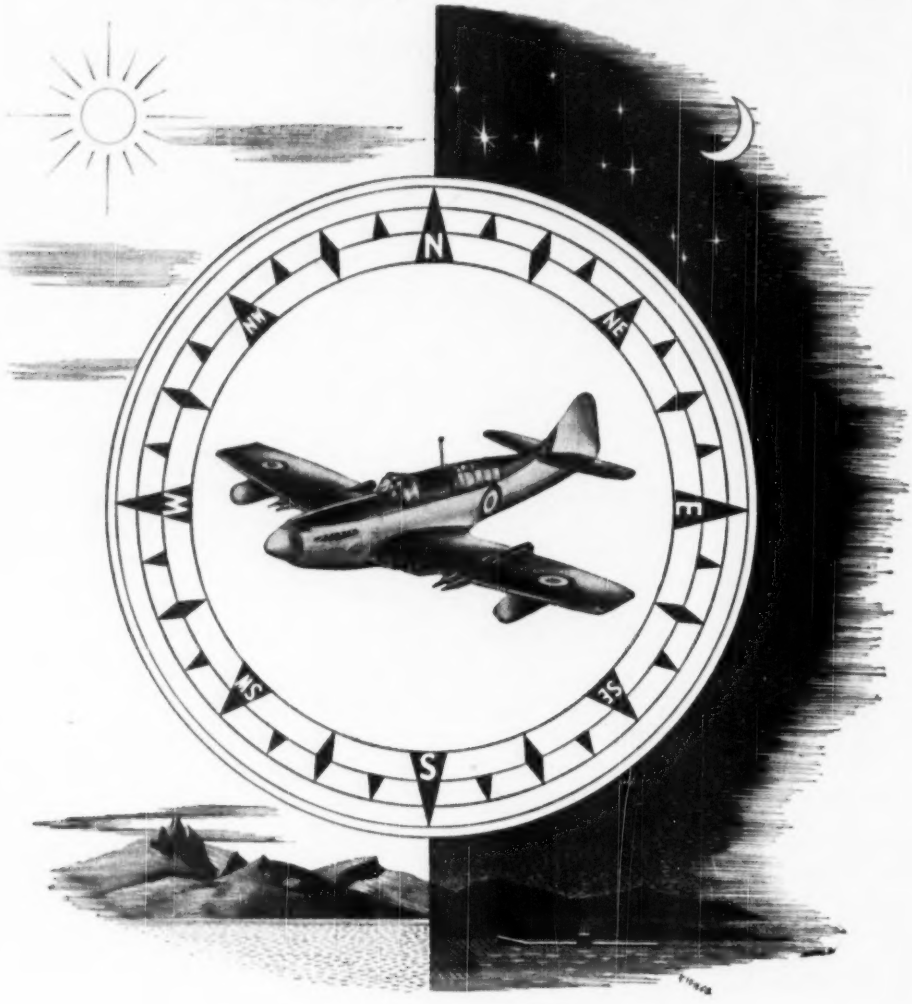

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The Professional Pilot

IN many respects the profession of air pilot is unique. Like his aircraft, his work is becoming more and more complex, and, though still numbered among the youngest professions, airmanship—to use the term in its full sense—is at once highly skilled, specialized and most responsible work. But a generation ago pilots might have been described as "happening" rather than "being produced," and learning to fly was not so very different from learning to ride a bicycle.

Today a long and very costly training is required for the professional pilot, and very few young men indeed are able to tackle commercial flying as they might another profession. Regrettable though this state of affairs is, there has been little urge to alter it for the good reason that a number of experienced ex-Service pilots has always been available to meet the requirements of commercial operators. It is not proposed to comment here upon the problems of a profession which for many is likely to cease, for medical reasons, at around the age of 45 and to offer practically no prospects of other employment of a similar nature afterwards.

All the difficulties of manning an airline have been intensified in recent years by rising costs, keen interline competition, increasing speed, and so on; and, moreover, the airlines can no longer call upon men with several hundreds of hours of day-and-night flying on four-engined aircraft, as was the case after the war. Even those few civil pilots who are without regular employment at the present time are now being made attractive offers to re-enter the Services, and within a few months a serious shortage may arise for which no quick or easy solution is apparent.

Elsewhere—on page 514—is described in detail a convenient plan which has been expediently worked out by B.O.A.C. This Corporation, which, incidentally, does not foresee any vacancies in its pilot ranks for the next twelve to eighteen months, is taking advantage of a redundancy among its skilled navigators—resulting from a policy progressively to reduce the size of crews—and, at a cost of about £1,000 per head, training many of them to be pilots, and this while the men concerned continue to carry out their normal duties. The scheme appears to be an admirable one, providing as it does a future for many navigators who might otherwise have to become super-numerary, preserving their flying and route experience in addition to their navigational skill and producing as well a considerable number of co-pilots to meet any future requirement.

B.E.A.'s Problem

Other operators—B.E.A. among them—may not be able to work out such a solution. There are still a few experienced pilots in the pool, and a few more may become available as certain charter concerns modify their activities. It is from such sources that B.E.A. hopes to make up its numbers during the spring. The expected expansion of its services will be partially looked after by the introduction of larger and faster aircraft, but upwards of 100 more pilots are also likely to be needed before next summer; it is worth noting, incidentally, that the Corporation has raised to 35 the upper age limit for pilots in possession of Commercial Licences.

With an expansion of the R.A.F. in progress, and an assurance of good pay and a worthwhile career for Service pilots in peace-time, very few will wish to exchange uniform for livery, and it is no longer possible, therefore, to depend upon this source to provide commercial aircrews in the future. The problem of training commercial pilots has been discussed often enough; soon some decisions must be taken in this regard with, more important, action to follow.

As a postscript we would draw attention to the University Squadrons. Many of the members are the ideal type of young man to become airline captains; they would have high academic qualifications, a first-class basic training as pilots, and, to judge by the proportion—only 5-8 per cent in recent years—who apply each year for commissions in the R.A.F., a good number might well be ready to consider the sort of civil flying career the Corporations could offer.

"Flight" photograph.

S/L. JOHN DERRY, D.F.C., joined the de Havilland Aircraft Company as an experimental test-pilot in 1947. In a D.H.108 experimental machine, on September 6th, 1948, he became the first pilot to fly a British aircraft faster than sound. Derry, who is 29, began his R.A.F. service in 1940 as a wireless operator/air-gunner. Later he trained as a pilot and flew rocket-firing Typhoons from 1944-45. After the war he served at the Central Fighter Establishment and, on his release, began his career as a civilian test-pilot with Vickers-Supermarine.

HIGH-SPEED FLYING

—*from a Pilot's Viewpoint : John Derry's R.Ae.S. Lecture*

MANY misconceptions concerning flight research into the relatively new problems of flying at high Mach Numbers should be removed by study of S/L. John Derry's paper, read before the Graduate Section of the Royal Aeronautical Society on November 30th, on high-speed flying from the test-pilot's point of view. The lecture, which attracted one of the largest audiences seen in the R.Ae.S. library, is summarized here under the five main headings chosen by the author. S/L. Derry prefaced his paper by reminders that he spoke as a pilot and not as a technician and that, for security reasons, most of his examples had been chosen from personal experience in aircraft now considered obsolete. His first section was entitled—:

Obstacles to negotiate at high and low altitude.—It was possible, he said, to isolate the effects of compressibility from the problems associated with high air-loads. To some extent the desire of both pilot and aerodynamacist to initiate all research at high altitude sprang from the same source; for a given true speed, indicated speed—dynamic pressure—was halved at 40,000ft and the speed of sound was 100 m.p.h. slower above 35,000ft. Another factor, often not appreciated, which affected the pilot was that it was, and would be for some time, impossible to break a normally strong research aircraft or fighter above 30,000ft. Also, control-forces were low at altitude, facilitating quick correction of load-increases caused by compressibility; and the pilot was able to abandon his aircraft without encountering the shattering effects of high air pressures.

Experience had shown that compressibility produced the following general symptoms: variations of hinge moment; flow breakaway causing buffet; changes in stability; tab and control ineffectiveness; and large unpredictable trim-changes. The last two effects were the most serious, and had given rise to confusing popular ideas about the "barrier." The most troublesome trim-change was nose-down—for manual or powered controls. In both cases the final result could be a very steep dive, either because of the trimmer's inability to relieve stick-force sufficiently or of complete ineffectiveness of control. Thus, a serious nose-down trim-change could result in genuine loss of control, although its onset was rarely too quick for some form of corrective action.

The author gave two instances of this vice. The first provided a reminder that few jets had exceeded the limiting Mach Number of the Spitfire (M=0.92, attained by S/L. Martindale, then of the R.A.E.). At M=0.83 in a Spitfire, a strong nose-down trim-change occurred, building up rapidly at M=0.85 until full nose-up trim was insufficient. At M=0.86 the aircraft could not be pulled out of the dive with a 150-lb stick-force. The uncontrolled dive lasted for a short time only because of the drag-increase caused by closing the throttle in fine pitch. The second example concerned the D.H.108. In this case, an uncontrolled dive resulted from a serious loss in elevon effectiveness, which demanded full "up" movement to trim at M=0.98. A relatively small nose-down trim-change at M=0.99 was enough to carry the aircraft into a dive. Additional trim was provided by trim-flaps, but these quickly became ineffective and only very prompt action prevented development of a vertical dive. There was no means of recovery until the terminal Mach Number fell below that at which control was lost. This condition was realized at 30,000ft, at which the T.M. was 1.0; a slow recovery was completed at 25,000ft at M=0.95. These examples, illustrating the worst effects of Mach Number, showed that the extreme case was not necessarily disastrous. S/L. Derry did not know of any crash which could be directly attributed to loss of control at high altitude as a result of compressibility effect. However, on more advanced aircraft, extra weight and lower drag might produce more serious results.

Nose-up trim-changes, more irritating than dangerous, produced, at the worst (at high altitudes), a "g-stall." This was not likely to prove catastrophic and, in practice, was rarely experienced unintentionally at high Mach Numbers. Swept-wing aircraft, exhibiting the now well-known tip-stall, entered this condition more suddenly; and for aircraft with spinning tendencies, the "g-stall" brought the risk of spinning. Fortunately, the "g-stall" was usually straighter than was the normal stall. Reduction of g gave immediate recovery.

Lateral trim-change had become an innocuous but some-

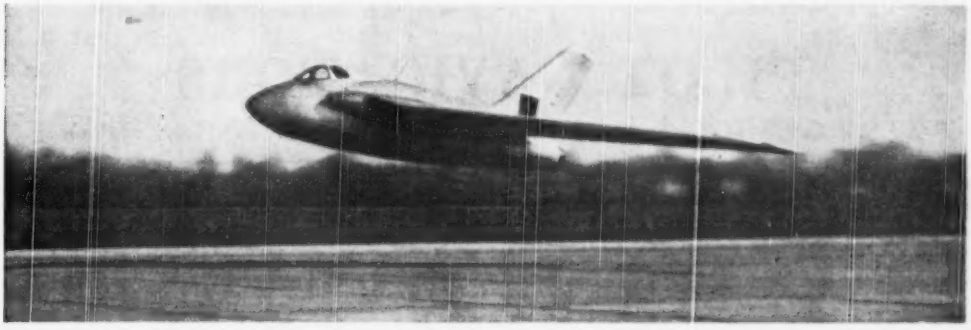
In America, the Bell X-1 and Douglas Skyrocket (above) research aircraft have proved their worth as practical instruments of supersonic flight-research. Both types employ rocket motors.

times deciding factor in the ultimate limit of swept-wing aircraft. In some cases it had been found possible to raise the downgoing wing by application of rudder towards that wing: the reverse of normal corrective action. Though it could be understood, the effect of yawing or unyawing swept wings at high Mach Numbers remained a new reaction for the pilot to master. Lateral control was bound to be more satisfactory and development to this end was in progress. Very large ailerons were an obvious solution.

The other symptoms of compressibility mentioned were, individually, little more than a distraction at high altitude, where there was a small element of risk produced mainly by the nose-down trim-change. At low altitudes, where control-angles assumed the significance formerly held by stick-forces on manually controlled aircraft.

Another leading requirement at present was for continuous transmission of all instrument-readings. The automatic observer was no longer sufficient. Continuous speech-recording was a step in the right direction, but until a telemetering system had been perfected the responsibility for missing nothing rested with the pilot.

Present and future requirements of high-speed research aircraft: It was essential to have sufficient thrust to negotiate the transonic region in a climb; thus the first requirement was for a rocket motor, as there seemed no immediate hope of developing gas-turbine thrust to the extent required



The author's experience of transonic flight was built up largely in testing the third D.H.108, the only British aircraft to have exceeded Mach 1.

misbehaviour stemmed from a combination of high dynamic pressure and compressibility, the most unacceptable form of vice was flutter, which the author took to embrace any undamped oscillation of control or aircraft with a frequency greater than ½ cycle per second.

A good illustration of a pitching oscillation was provided by the 108, in which damping was reduced by increased Mach Number and I.A.S.: on one occasion, despite careful, gradual increases, an undamped oscillation built up to +4 —3g at the rate of 3 cyc/sec. The final loss in damping from neutral to seriously negative occurred over a Mach range of 0.005—a variation which could occur through gusts, apart from the difficulty of maintaining Mach Number to such extreme accuracy. Controlled investigation was continued safely over the same Mach range [M = 0.87/0.875] at lower I.A.S.

Only one form of vice was likely to cause structural failure —extremely violent flutter. Failures at high speed from other causes were, almost without exception, due to design failure or overstressing by the pilot—and not of any mysterious phenomenon hovering like a spectre at the "barrier." A very large proportion of the risk and discomfort could be avoided by patient and painstaking build-up in the Mach/I.A.S. combination after thorough investigation of the Mach scale at maximum altitude.

The approach to high-speed investigation and means of obtaining test results.—Techniques developed over the past few years would, the author hoped, bear little relation to those of the near future. On the Spitfire and, to a lesser extent, the early jets, very uncomfortable dives were necessary to obtain Mach Numbers of up to 0.88. The arrival of the swept wing at once put us in the M = 0.86/9 bracket in level flight. This seemed to be the answer but, of course, was not. The real value of the swept-wing aircraft was its ability to explore Mach regions of up to 1. Thus we found ourselves in a dive again. It was possibly vital to know the dive-angle required to obtain a range of speeds at full throttle, and dive-angles were always over-estimated by pilots, particularly when they were seated in the nose of their aircraft. The Desyn, an instrument previously familiar only to the aerodynamacist, was becoming an important source of information to the pilot, owing to the critical nature of control-angle variations. Powered controls, with their artificial feel, strengthened the case for the Desyn as

Despite its short endurance, the rocket-powered Bell X-1 had made a steady and complete test at transonic and supersonic speeds on almost every flight. Larger air-brakes would be needed with increase in thrust. Landing-speeds should be allowed to rise (S/L. Derry quoted 200 m.p.h. as an acceptable speed—given suitable runways and advanced methods of deceleration). Further requirements were power-boosted controls and movable tailplanes, the success of which had already been demonstrated: no aircraft without a trimming tailplane had exceeded Mach = 1 in full control; the D.H.108 could not have been used for investigation beyond Mach = 0.88 without its powered elevons.

The unfortunate decision to delay construction of a British supersonic piloted aircraft had arisen, said the author, from an incorrect appreciation of what the pilot could cope with in an unconventional aircraft, particularly on take-off and landing and had resulted in the type of test-work described in his paper. Ironically, the risk involved had been far higher than would otherwise have been so; reports of flights with the Bell X-1 had left no doubts on this score. Concerning tailless aircraft, S/L. Derry said that pilots' impressions had, in general, been unfavourable. But, on the credit side, the D.H.108, which first flew in 1946, had had a level-speed performance equal to or greater than any other aircraft flying in this country—on 30 per cent less power. It was still the only British aircraft to have exceeded M = 1, although it was only in full control up to M = 0.98. In view of the aerodynamic and structural advantages of the tailless type, it was to be hoped that the delta-wing research aircraft now flying would give a better impression than the older configuration. Unfavourable impressions should not be too readily accepted at an early stage: in approaching supersonic flight, pilots would have to accept new standards. Some were already accepted.

Pilot-safety measures.—The improvement in maximum lift with increased Mach Number allowed "g-stalling" above 30,000ft equal to or in excess of "blacking-out g." It was essential to provide g-suits for research pilots and, in the near future, for fighter-pilots also. The prospect of rocket-powered, vertical-climbing aircraft brought a need to seek a remedy for the effects of negative g—which was more uncomfortable and demoralizing than positive g. Tight, well-fitting harness was vital. The problem of low atmospheric pressure could, if respected, be safely negotiated.

HIGH-SPEED FLYING . . .

Pressure cabins were essential to success above 42,000ft; the pressure mask and waistcoat permitted cabin-pressure failure at 50,000ft if descent began within 10-15 sec; above 50,000ft a full pressure suit was necessary to provide for an emergency. The ejection seat had proved itself very successful—at *indicated* speeds of up to 450 m.p.h. A vast increase in safe ejection-speed was necessary, and it seemed that the ejection seat would eventually be replaced by the detachable cockpit or fuselage section, as incorporated in the Douglas Skyrocket. It seemed certain that there could never be any satisfactory means of leaving an aircraft at very high indicated speeds below, say, 3,000ft—although there would always be miraculous exceptions.

Requirements of a high-speed research pilot.—The test pilot should be first and foremost a pilot, with the necessary temperament and keenness for flying itself. He should be determined and patient, and try everything more than once. The pilot need not be a fully trained aerodynamicist or engineer, although he should understand a considerable amount of theory and be trained in it—in the way the E.T.P.S. was doing at present. Contrary to popular opinion, he should appreciate fear. Complete absence of fright would result in poor test-results and often in catastrophe. Rivalry between firms and national security had to be respected, but exchanges of information and experience between pilots were tremendously valuable.

PILOT NAVIGATORS

B.O.A.C.'s Conversion Scheme : A New Source of Commercial Pilots : Pre-war Practice Revived

MOST of the world's airlines plan to reduce the number of aircrew carried in their aircraft. Obviously, very considerable economies can be effected if such a reduction can be achieved without reducing the standards of safety. Modern aids, already in use or foreseen for the near future, and designed to be automatic or pilot-operated, make this possible, and the crew compartments of several new aircraft are being laid out with fewer crew stations than has been customary. It is probable, also, that the introduction of gas-turbine power units, requiring fewer controls and dials than do piston engines, will hasten the "elimination," on some routes, of flight engineers. The Comet is a case in point.

As another example of crew reduction, B.E.A.'s Pionairs—DC-3 conversions by Scottish Aviation—will normally carry two pilots as the total aircrew, a "jump seat" being provided for a radio operator should one be called for on a particular flight. His sets are of the rack-mounted plug-in type. So far as long-distance routes are concerned, it will be recalled that Pan American Airways already operate Stratocruisers across the Atlantic in the summer with a crew comprising three pilots and two engineers. All of the pilots are qualified navigators. Before the war, pilot navigation was the normal practice. Not until experienced pilots who had only quite superficial training as navigators became available from the Services were navigators regarded as essential members of commercial aircrews.

B.O.A.C. have more in mind than crew economy in their conversion plans, and acknowledge their obligations to aircrew men who might otherwise become redundant. Moreover, plain navigators are not likely to be dispensed with altogether for several years.

Navigator-to-Pilot

Some months ago a scheme was worked out for the training of navigators as pilots within the Corporation—subject to certain qualifications. These men, it is pointed out, have the advantages of several thousand hours of airline and route experience in addition to specialized knowledge in their profession. Some 200 B.O.A.C. navigators were concerned in the scheme, and in addition to their crew qualifications, participation was subject to fitness, the obtaining of a Private Pilot's Licence (or the old pilot's "A" licence) and to an age limit (with certain exceptions) of 28 years.

To obtain a Private Pilot's Licence at one's own expense might seem to be a prohibitive provison, but in view of the existence of the Airways Aero Club, which is able to offer instructional and solo flying at unusually low rates of 30s per hour, the problem is not insurmountable. Aircraft and an instructor are available at Denham and Whitchurch, and, for a time, flying could be had at Hurn. Mr. L. W. Wenman, previously C.F.I. at Fairoaks, was recently appointed full-time C.F.I. to the Airways Aero Club at Denham.

Of approximately 200 navigators on B.O.A.C. strength, 117 applied to take part in the scheme and, of these, ten have been rejected because of their age; 28 have subsequently dropped out for family reasons or because of unsatisfactory progress in early flying lessons; and 79 remain in the scheme. It may be added that some 112 plain navigators now remaining, and who will not be converted, can be fully occupied for some years to come on long-distance routes where their services are required.

The progress of the 79 is going according to schedule. The Corporation does not expect to need any new pilots for at least a year and it may, in fact, be possible to arrange a transfer of a few B.O.A.C. pilots to B.E.A. whose need is likely to be urgent in the spring. As a result of previous experience at the controls, two navigators have already completed training up to Commercial Pilot's Licence standard; about 40—half of the total—have begun what is called their sponsored training; and the remainder are still in process of getting a private pilot's licence.

The training syllabus from private licence to co-pilot standard, similar in many respects to R.A.F. training, runs smoothly alongside the navigator's normal duties on the routes and is expected to take about eighteen months. It does, however, call for hard work from each individual, including technical study and a good deal of spare-time flying. Navigators keep their own four-section progress card.

Aircraft used up to Commercial Pilot's Licence standard are Austers and Magisters, and the total flying experience required is 150-200 hours.

Details of the flying training to follow have still to be finalized, but conversion to and 50 hours' flying in Oxfords or similar light twins should provide the next logical stage of experience and at the same time enable an instrument rating to be obtained.

A Bigger Step

The next step from commercial pilot with minimum experience to co-pilot of a large aircraft is likely to be a big one and to take time. Experience will probably be built up on the routes while flying as navigator/third pilot; then the full conversion course to, say, Stratocruiser will be taken together with the technical course and perhaps a double ration of Dehmel synthetic training.

Incidentally, increasing use of synthetic trainers (flight-simulator courses) is foreseen in both Corporations, and a new Link machine, now under construction, is to be tried out in this connection. Redifon are making a Dehmel-type trainer for B.O.A.C., but it is understood that some slight delays have resulted from late delivery of the Stratocruiser nose.

Among other requirements, a pilot on conversion must make six take-offs and landings on the new type of aircraft to the satisfaction of a qualified captain.

The first few navigator pilots under the B.O.A.C. scheme should become available late next year, and the majority during 1952. Even though these men will start at the bottom of the pilot list regardless of previous experience as navigators, it is stated that they will be better off and have much better prospects than would otherwise have been the case. It is understood that they have not been, and will not be, required to enter into any new long-term engagement with the Corporation in connection with their sponsored pilot-training.

Rough estimates of the costs and savings concerned with this conversion scheme, and the policy of reducing the size of crew, are surprising. In round figures, each navigator is expected to cost £1,000 to train to co-pilot standard. Saving in salary and expenses may eventually amount to nearly £400,000 annually. The reduction of each aircraft crew by one man, together with the removal of his crew-station and gear, should increase payload by 250lb. Considered from this point of view, each man can pay for this training in a matter of weeks, flying as co-pilot in a crew of reduced size, the aircraft carrying one extra passenger. Undoubtedly the new B.O.A.C. policy will result in marked economies and will help to meet the requirement for pilots for a few years longer. Perhaps by then world conditions and technical advances will permit the R.A.F. to provide pilots once more.

Madam: No. But there are some people called T.I. Aluminium, who make large quantities of Aluminium and Aluminium Alloys. We are engineers, metallurgists, research enthusiasts and skilled workmen—a combination which works out well in terms of Aluminium (sheet, strip, extrusion or tubes). So you can say this for your Chief: his full stops may be missing, but he's very much all there in choosing his suppliers . . .

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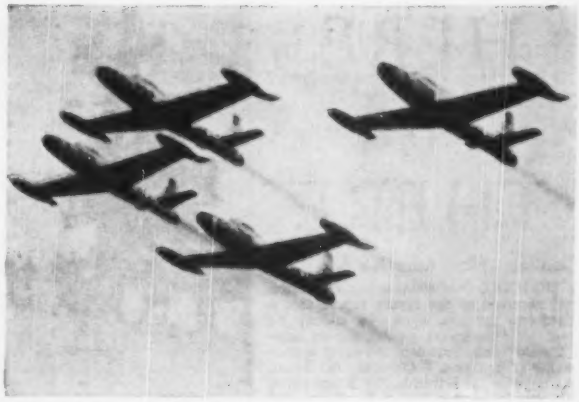
THUNDERJETS ON THE MOVE

Return Transatlantic Trip by 60 American Fighter-bombers



"Flight" photograph

A "low pass" by four Thunderjets of the 20th Group in diamond formation. Incomplete combustion causes the tailpipe trails.

MANSTON, Kent, has been the base for the Republic Thunderjets of the 20th Fighter-Bomber Group, U.S.A.F., since last July, when they flew there from their permanent H.Q. at Shaw, South Carolina, via Labrador, Greenland and Iceland. Last week the Group was preparing for its return. At the week-end, the aircraft left to fly to Prestwick, from which point they were due to return to Shaw by the same Northern route as soon as weather conditions permitted.

The Group's four-month stay in Britain resulted from an extension of the "rotational training" programme under which B-29 and B-50 formations have become regular visitors to this country. The 20th Group was the first fighter unit to be affected by this scheme. No jet-fighter replacements for the Group have so far been announced, and, if none arrive, Manston (which has a 3,000-yd main runway) may well be taken over by R.A.F. B-29 or jet squadrons.

The Group, which is commanded by Col. John Dunning, comprises three squadrons, each with an establishment strength of 25 F-84D Thunderjets; actual strength of the Group at present is slightly reduced. The squadrons are the 55th (Lt.-Col. Mitchell); the 77th (Lt.-Col. Davenport) and the 79th (Maj. Anderson). Blue, red or yellow nose, tail and tip-tank markings identify the aircraft of each squadron. During the war, the 21st Group operated from England—first with Thunderbolts, then with Mustangs—as part of the Eighth Air Force. It was employed on tactical duties and, after D-Day, provided continuous air support for General Patton's armoured columns. The Group was disbanded after the war and re-formed again at Shaw in 1947; after flying Mustangs for a short time it became the second U.S.A.F. group to receive Thunderjets. To-day it is part of the Strategic Air Command and its main duties are ground-attack and bomber-escort. During Exercise *Emperor*, the recent combined manœuvres, two squadrons were engaged on escort and intruder work, while the third joined the defending forces as intercepters. Since the Group's arrival here in July, each squadron in turn has spent a week at Waterbeach exercising with resident R.A.F. Meteor squadrons. Further examples of inter-Service co-operation are found within the Group itself, which employs officers from four separate services: S/L. C. D. Bricker, R.C.A.F., is executive officer of the 79th Squadron; F/L. C. J. Barrey, an Australian R.A.F. Meteor pilot, is armament officer of the 55th Squadron; and Maj. A. J. Armstrong, of the U.S. Marine Corps, is attached to Group operations section.

As mentioned earlier, the Group is equipped with F-84Ds. A single axial-flow turbojet of 4,000lb thrust—the early-model Allison J-35—powers the F-84D, which has a maximum sea-level speed of about 600 m.p.h. By British standards, the aircraft is not suitable for modern interception work, as it takes over 20 minutes to reach 30,000ft when carrying tip-tanks. However, its endurance is considerably greater than that of contemporary British types: its three internal tanks are of 333 gallons total capacity and two tip-tanks bring the total to 700 gallons. Endurances of practically three hours are thus possible and the "combat radius" is quoted as 850 miles. The Group expects to be re-equipped shortly with the later F-84E-model Thunderjet, which has a 1,200-lb increase in thrust, correspondingly increased performance and a greater range.

As a ground-attack weapon, the Thunderjet is excellent. A typical offensive load is two 1,000-lb bombs plus eight 5-in rockets, and this, of course, is supplemented by the standard armament of six 0.5-in guns—two in the wings and four in the top decking of the fuselage nose. The F-84's boosted ailerons and its pilot's g-suit are an effective combination in countering the high control-loadings and accelerations met during ground-attack work.

The American fighter squadrons work to an intense and comprehensive training schedule, and their pilots probably log two or three times more flying hours annually than their British counterparts (this is partly accounted for by the longer endurance of their aircraft). Pilots' flying-time over a 12-month period is recorded under 38 separate sub-divisions, covering aerobatics, G.C.A. landings, night and all-weather flying, navigation and all aspects of operational work (gunnery, rocket-firing and bombing training is particularly concentrated). Great stress is laid on squadron mobility.

Under guard—a Republic F-84D Thunderjet, photographed at Manston shortly before the Group began its return journey to America. The 180-gallon tip-tanks are carried by F-84s for nearly all their missions.

"Flight" photograph

A NEW "BRASSEY'S"

"Brassey's Annual, 1950," edited by Rear-Admiral H. G. Thursfield. William Clowes and Sons, Ltd., Little New Street, London, E.C.4. Price 50s.

KNOWN for 64 years as a naval year-book, "Brassey's" now appears in new guise: as a record devoted to the yearly progress—strategical and technical—of all three Services. Most aspects of military aviation are represented in the contents. Over half the illustrations depict aircraft, and there are chapters on the influence of air power, the development of naval aviation, foreign air forces, post-war developments in military aviation, and R.A.F. history, organization, function, training and manning.

HERE and THERE

Canberra for America

OFFICIAL confirmation has now been received of the recent report that a Canberra jet bomber would shortly be sent to America to participate in comparative trials between low-level troop-support bombers. General Al Boyd, commander of Edwards Air Force Base, Muroc, is among U.S.A.F. pilots who have flown the Canberra in Britain.

Impure Ices

THE mysterious "ice bombs" which have recently been falling in various parts of the country have now, it appears, been authoritatively identified as deposits of ice which, having formed in the waste-pipes of airliner wash basins, become detached as the aircraft descend into warmer layers of air. Preventive measures are being taken by modifying outlet pipes.

Recognition for Inventor

THE Royal Commission on Awards to Inventors last week recommended an ex-gratia payment of £1,000 to Dr. N. A. de Bruyne for his development of the strip-heating process for speeding-up glue setting in the construction of wooden aircraft. It was extensively applied in the manufacture of Mosquitoes and other types during the war. Dr. de Bruyne—formerly Junior Bursar of Trinity College, Cambridge—is the founder and managing director of Aero Research, Ltd., Duxford. In connection with the same process, the old-established London furniture firm of Harris Lebus, Ltd., has been recommended for an award of £500.

SWEEP BEFORE STRIKE: Men of the U.S.S. "Badoeng Strait" clear ice and snow from the flight deck in preparation for a strike on the North Korean coast by the Corsairs in the background. The "Badoeng Strait" is an 11,000-ton escort carrier with capacity for over 30 aircraft.

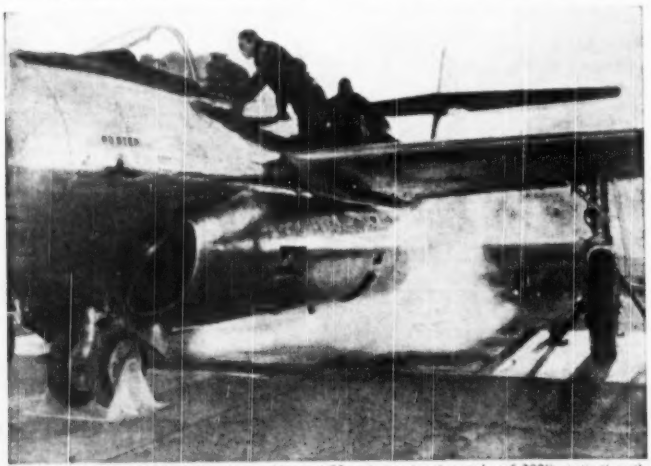
Into Line

FOLLOWING the example of the U.S. Air Force, which adopted nautical units for navigation and speed computation as far back as 1946, the Civil Aeronautics Administration has now ruled that, with effect from July 1st, 1952, speeds of all civil aircraft are to be registered in knots. This practice—adopted by the R.A.F. some years ago—will permit standardization of instruments so that both civil and military aircraft can make full use of new electronic navigational aids now under development.

F-80 versus Mig-15

RECENT combats over Korea seem to have proved—as might be expected—that the swept-wing Soviet Mig-15 jet fighter is faster, though possibly less manœuvrable, than the American F-80 Shooting Star. In a recent issue of *Life*, Lt. Russel Brown, an F-80 pilot, described an encounter with one of the Russian jets: "I saw no markings on the plane—just a shining chunk of aluminium streaking ahead of me. Then he veered to the left . . . he could climb faster than I could but when he turned I cut him off and got in four short bursts. . . . "

The Mig dived and Lt. Brown followed: "My air speed was indicating over 600 m.p.h. but I couldn't gain." After five bursts from 1,000 ft, claimed Lt. Brown, the Mig exploded in the air.



SCORPION ON SCALES: With its two Allison J-35 turbojets (each rated at 5,200lb static thrust) running at full power, this Northrop F-89 Scorpion is mounted on the universal thrust-measuring stand at Edwards Air Force Base, Muroc. The stand, also designed by Northrop, consists of floating tables to which any kind of aircraft can be rigidly attached for measurement of forward thrust.

AIRCRAFT OF THE YEAR

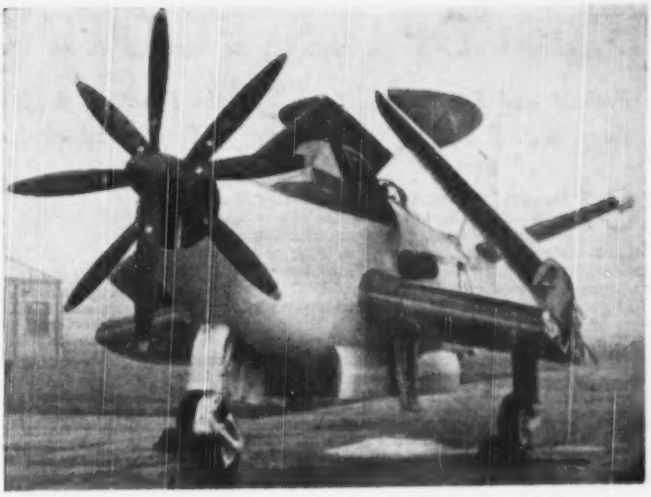
Notable British aircraft of the past year will be the subject of a feature article in the Christmas number of *Flight* (December 21st): this will be an enlarged issue, with special articles in addition to usual contents.

Centrifugal v. Axial

A DISCUSSION on the relative merits of centrifugal- and axial-type gas turbines is taking place this evening, December 7th, before the Royal Aeronautical Society. The protagonists are Dr. E. S. Moult, B.Sc., F.R.Ae.E., M.I.Mech.E., of de Havillands, and Mr. H. Pearson, B.A., A.F.R.Ae.S., of Rolls-Royce. The meeting, beginning at 6 p.m., takes place at the Institute of Civil Engineers in London.

Canadian Air-Sea School

CANADA announces the formation of a joint R.C.N.-R.C.A.F. Maritime Warfare School, an establishment corresponding to our own joint Anti-submarine Training School at Londonderry. The Canadian school, to be based at a Naval barracks at Halifax, will conduct joint courses for Naval and Air Force personnel with particular emphasis on anti-submarine warfare. Classroom



TWOFOLD : As a result of recent test-flying, the Blackburn and General Aircraft Y.B.1 anti-submarine prototype (Armstrong Siddeley Double Mamba) has been fitted with extended wing-tips. The makers state that the increase in aspect ratio is beneficial in reducing induced drag in the single-engined cruising condition. The folding method is similar to that used on the Supermarine Seafire.

studies will be supplemented by practical exercises at sea, employing surface ships, aircraft and submarines.

American Rocketry

A MARTIN Viking Naval rocket, launched from the White Sands proving ground, New Mexico, has set up a new single-stage altitude record, for American rockets, of 107 miles. An ex-German V-2, also launched from White Sands, exceeded this figure by seven miles. The two-stage rocket record—held by a Wac Corporal missile air-launched by a V-2—is 250 miles.

Globemaster Overload Tests

TAKING off successfully at a gross weight of 194,500lb, the Douglas C-124A Globemaster recently exceeded its designed gross weight by nearly 20,000lb. Its payload at the increased weight is 50,000lb for a range of 2,500 miles. This production version of the Globemaster was recently adapted as a paratroop-dropper by the provision of two rear-fuselage doors in addition to the "clamshell" entry in the nose. As a trooper, the C-124A can carry 200 armed men.

Avro Canada Resignation

MR. WINNETT BOYD has resigned his post as assistant chief engineer and chief designer of the gas-turbine division of A. V. Roe, Canada, Ltd., in order to establish his own consulting practice in Toronto. Through his design work on Canada's first and only aircraft turbojets, the Chinook and Orenda, Mr. Boyd has played a major part in Canadian jet development; his association with the aircraft industry is expected to continue. This association, incidentally, began in 1943, when Mr. Boyd was sent to England by the Canadian National Research Council to work under Sir Frank Whittle at Power Jets, Ltd.

NEWS IN BRIEF

A DANCE for past and present students of the College of Aeronautical and Automobile Engineering (Chelsea) is being held at Victoria Hall, Bloomsbury Square, London, W.C.1, on Wednesday, December 13th. Tickets from 102, Sydney Street, London, S.W.3.

* * *

Following the recent transfer of business interests in R.I.A. shims from Gerrard and Co., Ltd., to the Linoleum Manufacturing Co., Ltd., the latter firm state that they have appointed B. Attewell and Sons, Ltd., Reflection Works, Southall, Middlesex, as their sole distributors of these products.

* * *

With a thumbnail sketch on each page showing famous aircraft-types which, from 1911 onwards, have been doped with Cellon, a completely new edition of the *Cellon Aircraft Finishes Booklet* has appeared. As well as listing the full range of civil and military finishes, it contains much useful technical data for users.

Teleflex Products, Ltd., Chadwell Heath, Essex, state that the Ministry of Supply has granted design approval for their reaction-type mechanical remote controls.

* * *

On January 1st, Mr. P. J. Ferguson will relinquish his appointment as Scottish Branch manager of the British Aluminium Co., Ltd., in order to take up the post of export sales manager at the London headquarters. Mr. M. J. J. Richards succeeds him in Scotland.

* * *

Nife Batteries, of Redditch, Worcs, announce the introduction of a new series of portable floodlights incorporating a number of improvements. The nickel-cadmium batteries employed have the characteristic of retaining their charge however long they are left unused.

* * *

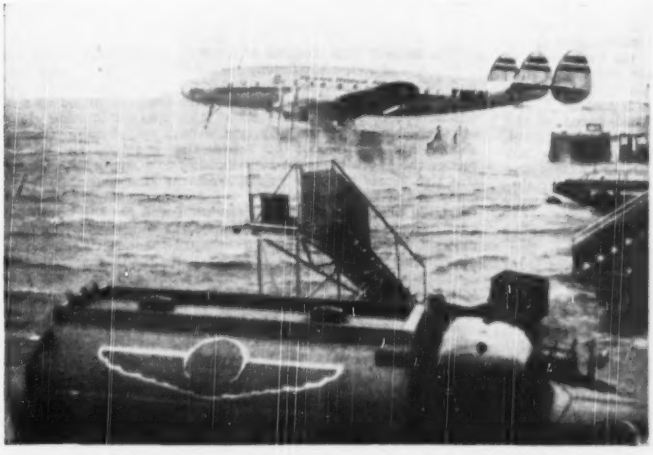
Production engineers who use Monel, nickel and Inconel will find much useful guidance in a 52-page booklet on the hot working, annealing and pickling of these materials; copies are obtainable from Henry Wiggin and Co., Ltd., Wiggin Street, Birmingham, 16.

* * *

A correction of information supplied now makes it apparent that the makers of the model Bristol Fighter sent by Rolls-Royce, Ltd., to the Australian War Museum (and illustrated on p. 453 of *Flight* for November 23rd) were Dagra Models, the Aerodrome, Eaton Bray, Leighton Buzzard, Beds.

* * *

Elliott Brothers (London), Ltd., Century Works, Lewisham, London, S.E.13, who this year celebrate their 150th anniversary, are compiling an authentic record of their activities; they would be grateful to learn the whereabouts of any of their drawing, electrical and other instruments made during the nineteenth century.



PORT IN A STORM : Flooded by rain and the overflowing waters of Flushing Bay, La Guardia Airport took on the appearance of a marine base during the great storm which struck New York on November 25th. In this scene a Constellation and tanker are almost awash.

HELICOPTER PILOTING

Present and Future Procedure from the Practical Angle : Captain J. S. Fay's Lecture to the Helicopter Association

The author of the paper : a photograph taken at the inauguration of B.E.A.'s Liverpool - Cardiff helicopter service.

ON Saturday, November 25th, an unusually interesting paper, entitled *Some Present and Future Aspects of Helicopter Piloting*, was presented before the Helicopter Association by Captain J. S. Fay, of the B.E.A. Helicopter Unit. It was divided into seven sections, *viz.*, navigation, emergency landings, controls, pilot comfort and the problem of pilot fatigue, pilot training, instrument flying and night flying. An abstract of the paper is given below.

The lecturer began by citing the differences in cross-country flying technique as between the helicopter pilot and the fixed-wing pilot. The helicopter pilot examined small patches of countryside closely, whereas the fixed-wing pilot gained a general impression of a large section of country. In addition, the helicopter pilot had to make a greater allowance for wind and, when visibility was below one mile and the country was strange to the pilot, it became difficult to maintain a predetermined track, and it was usually simpler to follow a railway or main road. Maps could be improved for the helicopter pilot, thought Capt. Fay, by indicating the runways and boundaries of airfields, by showing all high-tension cables that were more than one mile away from towns, by naming all railway stations, and by accurately defining the shapes of woods.

In pure D.R. navigation—as, for example, in flying over the sea—a helicopter might be in a slightly yawed condition without the pilot realizing it: it was therefore necessary that a sensitive yawmeter should be fitted as additional navigational equipment. Navigation, especially at night, was restricted by the instability of present helicopters. A pilot could never let go the cyclic-pitch stick to plot QTEs or work out his position from Decca co-ordinates. However, it was fortunate that, with helicopters on the threshold of operations for which accurate navigation would be required, an exact and almost foolproof system of navigation was about to reach the production stage. This was the Decca Flight Log, a device in which a stylus moving over a map showed the obtaining ground position of the aircraft at all times, and left a track on the map of the ground which had been flown over.* Thus, for the first time, pilots would have an apparatus which would give them an accurate presentation of their ground position without any necessity for mental calculations, and without their having to take their hands off the controls.

Emergency Landings

Under the heading "emergency landings," the lecturer stated that there were many reasons why the helicopter pilot might not immediately appreciate that his engine had failed, and it might be quite easy for the critical stage in rotor r.p.m. to be reached before a reduction in pitch was effected, with the result that the blades would cone upward; and once a certain limit was reached, there was nothing the pilot could do to save the aircraft from disaster. At the best, the time available was not much more than five seconds; at the worst, less than three. In the event of the pilot reducing pitch in time, he then had to select his landing area and adjust his approach. Flare-out landings were safer because the forward speed of the aircraft was practically nil during the final arrival on the ground, and even a comparatively bad landing was unlikely to hurt the occupants, though the aircraft might suffer. Following the actual flare, the next trial of judgment was the application of collective pitch. Broadly speaking, the pitch lever could be pulled up only once.

As to what the pilot required to make the helicopter safer in the event of engine failure, Capt. Fay suggested that, first, if helicopters could not be designed so that the blades were always within the autorotative pitch range, then there would have to be some kind of automatic pitch-reduction device which would prevent blade-stalling in the event of engine failure. The device would need to have a manual cut-out system to make it inoperative when the helicopter was hovering close to the ground. In such circumstances, the pilot's reaction in the event of engine failure was to *increase* collective pitch, either immediately or a split second after lowering the lever. It was also desirable that blades should have a high moment of inertia, and, coupled with it, a wide range of r.p.m.; thus, by use of extra kinetic energy stored in the blades, a combination of high-inertia blades with extra r.p.m. in autorotation would make possible several seconds' hovering following an engine-off approach. Some sort of warning device would also have to be fitted so that the pilot was immediately aware of any power loss and the automatic reduction in pitch, and could thus gain valuable seconds for adjusting his flight-path and choosing a landing field.

Dealing with helicopter controls, the lecturer said that he wished designers would always ensure that the cyclic-pitch-stick trimmers always had ample range to cope with all c.g. positions, including those which were offset laterally. He would also like to see a trimming system that actually worked on the blades themselves, or as near to the blades as practicable, e.g., on the swashplate. He also thought that, for a right-handed person, the cyclic-pitch stick was the natural one to have in the right hand, with the collective pitch lever in the left.

Throttle design was a subject of some contention, but the spade-grip type as used on the Air Horse had a lot to commend it: to a certain extent, it operated in a natural sense, in that it was moved clockwise to open, and therefore moved in the same way as the tachometer needles. Furthermore, it was possible to refer to its position by feel, and obtain an approximation of the power setting at any time. Automatic pitch-change devices in which rotor-blade angles were automatically changed with a change of r.p.m. or torque were praiseworthy but, in their simplest form, had the drawbacks that there was no "cushioning" available for power-off landings, nor was there means of adjusting the pitch setting for height compensation.

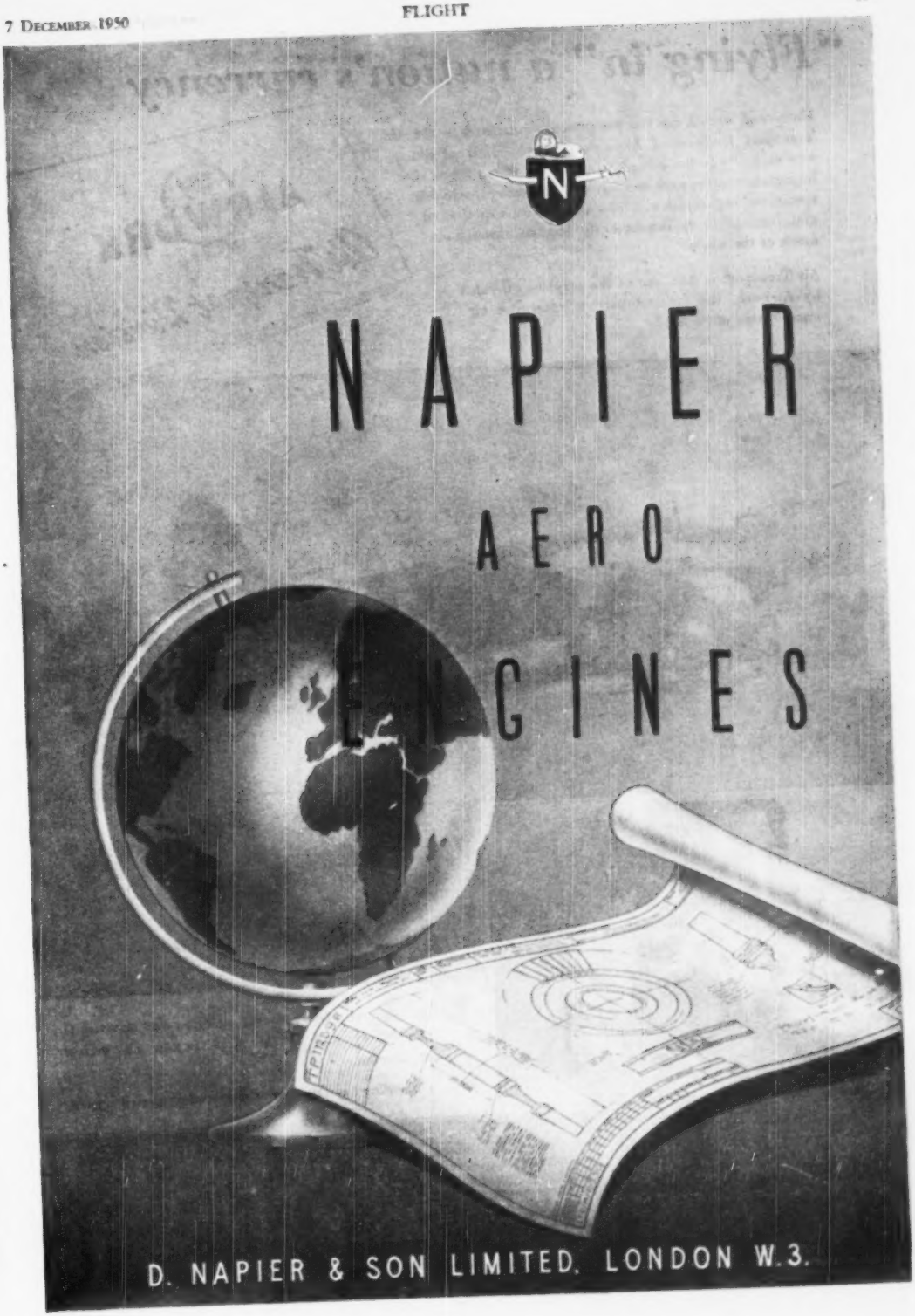
Capt. Fay felt that the yaw control should be such that, at its maximum weight, the helicopter should be capable of being rotated through 360 deg. about its normal axis, against rotor torque in winds up to 20 m.p.h.; and that in autorotation it should be possible to rotate the aircraft in the opposite direction to the rotor when flying at 20 m.p.h. It was not that a pilot would necessarily require to do these things, but rather that he could feel that extra reserve of control was available.

Increasing Comfort

The lecturer then went on to make a series of suggestions on the design of controls, whereby pilot comfort could be enhanced and fatigue reduced. He also made the point that the cockpit should be heated to a sufficient degree that the inside of the windscreen could be kept clear of mist and the outside clear of ice. Noise, particularly radio background-noise (which should not exist) could be maddening at times, and could reduce the pilot's vigilance and efficiency to a low order. There was also plenty of room for improvement in smoothness, especially in the low-frequency range, for vibration tended to make the body physically tired, and the brain also got tired and the eyes suffered some strain. Eyestrain was also caused by looking through bubble-type windows, or semi-spherical windscreens of material which was not optically perfect. In the lecturer's opinion, a flat, sloping surface should be used for the windscreen, as it could be kept clear of rain and snow by a normal type of wiper.

In dealing with pilot training, Capt. Fay gave a complete schedule for flying instruction, both for a helicopter conversion course for fixed-wing pilots and for an *ab initio* instruction course. He observed that the fixed-wing pilot had something which the *ab initio* pupil would take a long time to gain: he had air sense. That was to say, the fixed-wing pilot had gained a well-established knowledge of approach angles, circuit procedure, acceleration forces to be expected in various manœuvres,

* See "Flight," June 2nd, 1949, and March 2nd, 1950.—*Ed.*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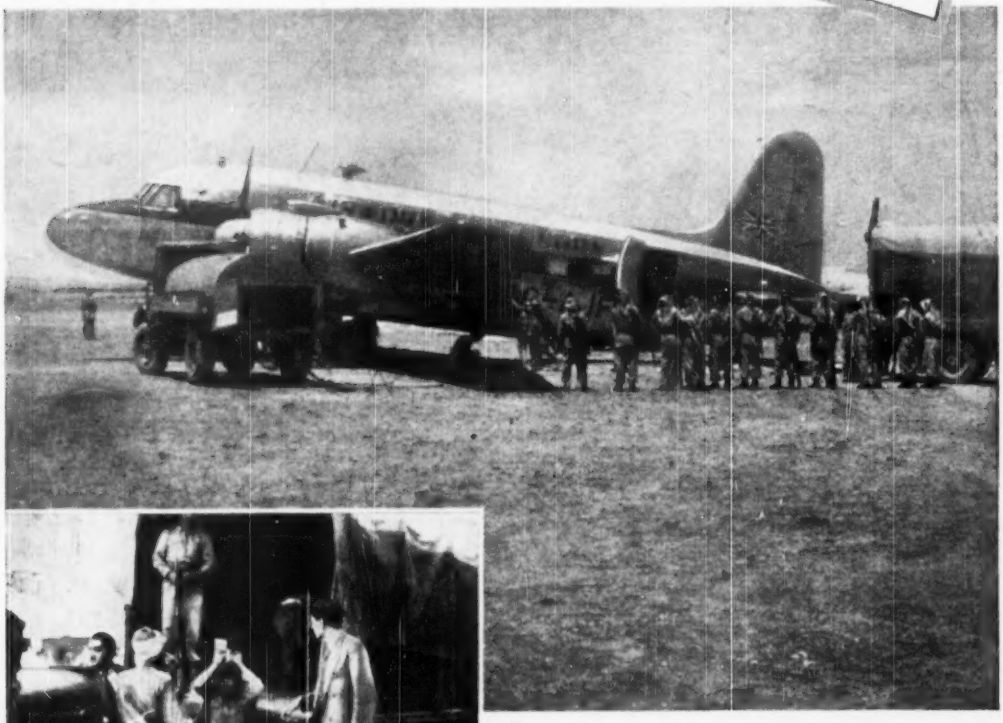

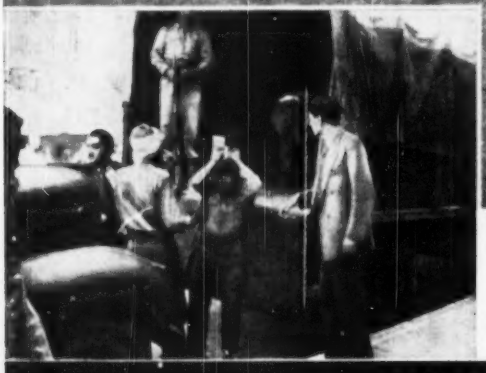

An Airwork Viking aircraft carrying new currency is guarded by men of the Arab Legion on arrival at Amman.

Unloading of the currency under armed guard.

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HELICOPTER PILOTING . . .

instrument interpretation, engine handling, and night and blind flying. Furthermore, he had the almost automatic ability to move the stick and rudder pedals in the correct direction, whilst, on the theoretical side, he had a wide and practical knowledge of navigation, signals, theory of flight, meteorology and aviation law. These advantages far outweighed the slight disadvantages the fixed-wing pilot might have as regards some of the habits ingrained into him during his time on fixed-wing aircraft.

Some of the main differences which the fixed-wing pilot would encounter were (i) the throttle was not closed when the aircraft was descending, but was used to maintain constant r.p.m.; (ii) when maintaining a constant heading, the rudder-pedal position was not necessarily a neutral one; (iii) the helicopter angle of approach for landing was steeper than that of the fixed-wing aircraft, and, when overshooting, it was rarely necessary to go round again, but was enough merely to reduced air speed; (iv) it was possible to reduce air speed to zero without the loss of control and lift which occurred in the fixed-wing aircraft. As to educational and physical requirements, the lecturer did not believe that there should be any difference in qualification between the intending fixed-wing pilot and the intending helicopter pilot.

Instrument Flying

Of instrument flying, Capt. Fay stated that much fatigue could be eliminated and instrument flying made easier by careful positioning of instruments in the panel. In determining these positions, two factors stood out above all others, viz., the relative importance of the instrument in enabling the pilot to maintain control, and the distance the eye had to move when obtaining the information from the dial itself. In the first case, it was obvious that the artificial horizon should command a central position; in the second case, an instrument such as the rate-of-climb indicator, where the pilot was interested only in the extreme left-hand side of the dial, should be somewhere on the right-hand side of the panel—in this way an unnecessary movement of the eye right across the face of the dial would be eliminated.

It was worth while to review how helicopter flight, as it applied to instrument flying, differed from that of fixed-wing aircraft. (i) The helicopter had a pendular swing, mainly longitudinal, under the rotor, thereby making control movements somewhat more complex than those required in fixed-wing aircraft; (ii) due to the pendular swing, and for other reasons, the helicopter was markedly unstable; (iii) there was a time-lag in response to movement of the main control, i.e., the cyclic-pitch stick; (iv) the attitude of the fuselage often bore little relation to the flight-path of the aircraft; (v) as compared with the fixed-wing machine, the helicopter had an extra flying control, the collective pitch-lever; and (vi) a change of power meant a change of torque and, therefore, a tendency to swing in the yawing plane.

After dealing with the various instruments in detail, Capt. Fay went on to examine the reasons why at present it was not practicably possible to carry out normal manœuvres at speeds below 40 m.p.h. under instrument-flying conditions with the normal instruments. (1) More control movements were necessary for precise flying, and the tendency to over-control increased. (2) There was a marked increase in possible differences between fuselage attitude and the flight path; the correlation of the artificial horizon, rate-of-climb indicator and the A.S.I. in order to obtain a mental picture of the flight-path was not possible when these differences were too marked. (3) The directional stability of the helicopter decreased as speed fell, and there was no instrument which could tell the pilot in which horizontal direction the helicopter was moving through the air. (4) Although the effect was momentary, a gust tended to produce a relatively large change to the indicated air speed. (5) In slow-speed descents, when the angle between the fuselage and the flight-path was greatly increased, the present A.S.I. became inaccurate, because the pitot head was not facing directly into the airflow. (6) Translational lift was lost at slow speeds, and an accurate and immediate indication of changes of motion in the forward plane was required by the pilot: this was not given by the present type of rate-of-climb indicator, where the static vent could be adversely influenced both by rotor downdraught and the motion of the fuselage through the air. (7) In forward, or near-forward, powered descents, considerable disturbance was made when the helicopter was flying through its own down-draught.

In view of these and other matters, some requirements which helicopters would need to enable them to be flown by reference to instruments at slow speeds could be laid down: (1) The helicopter should have a good measure of stability about all three axes at slow speeds and when hovering. Fewer control movements would then be necessary, gusts would have less effect on the helicopter as a whole, and the consequences of the turbulence encountered in vertical powered descents would not be so great. (2) There should be an indication of the helicopter velocity relative to the air in the horizontal plane; indication should also be given of any tendency of the helicopter to change direction and speed. In the U.S.A., a system whereby the angle of tilt of the plane of the rotor disc relative to the horizon was measured continuously and indicated to the pilot had been used with some success. (3) The accuracy and sensitivity of the rate-of-climb indicator as fitted to helicopters needed to be increased.

These were the primary requirements, but one or two others could be added, especially when helicopters would be required to carry out blind approaches: (i) The helicopter should have one less control—if the throttle and collective-pitch lever could be combined the pilot would have a less exacting task; (ii) a radio altimeter should be fitted; and (iii) there should be an accurate indication of translational motion relative to the ground—the lecturer visualized this last-named as a form of Decca Flight Log.

The ways in which night flying of helicopters differed from night flying in fixed-wing aircraft were mainly concerned with the approaches and landings to small sites as opposed to large airfields. As a bare minimum, the pilot required to see the ground sufficiently to take off and hover prior to the climb-away. The starboard navigation light gave enough illumination for this purpose. However, it was not always desirable to do things the hard way, and basic ground equipment should include the provision of lights strong enough to enable the texture of the ground to be seen reasonably well when hovering at a height of 50ft. The sequence of taking off and attaining a normal climb should be as follows: after leaving the ground, a vertical climb should be carried out to a height of 50ft., the cyclic stick then being pushed forward and a translational climb at normal climbing speed begun.

In order to land easily and safely at night, the pilot must know the wind direction; he must be able to see the ground, preferably with the aid of lights on the ground and by using the aircraft lighting; and he must be able to obtain from the ground lighting an indication of the horizon so as to enable him to retain the aircraft level laterally when not looking at his instruments.

In the case of engine failure in a single-engined helicopter at night, it was necessary for the pilot to see and choose a landing area and then to be able to touchdown visually. Both of these requirements pointed to the need of parachute flares. Should the need arise for a landing to be made in an unlit field at night, the parachute flares could be used for selecting a field and, if possible, for augmenting the aircraft landing lights during the approach. The main landing light should be a spot-light and should be adjustable in the fore-and-aft plane. For the touchdown, a lamp with a wider and diffused arc was of assistance.

AWARDS TO H.P. APPRENTICES

AIR MARSHAL SIR EDGAR LUDLOW-HEWITT (chairman of the board of governors, College of Aeronautics, Cranfield) and Dr. Richardson, Principal of the Northampton Polytechnic, were guests at the recent annual prizegiving to Handley Page technical apprentices.

Sir Edgar said that while young men should learn to investigate and analyse special problems and so learn to concentrate their efforts towards a specific objective, they should guard against becoming too narrow in their outlook. He was sure that the man with the broadest knowledge was the best specialist.

Dr. Richardson spoke of the close co-operation which existed between the Polytechnic and Handley Page, Ltd., and said that over a hundred apprentices attended either part-time day or evening classes.

Sir Frederick Handley Page stressed the value of workshop experience to the aeronautical engineer. An appreciation of the shops' point of view and the practical problems met there was invaluable to the would-be designer and indispensable to the production engineer. In a good apprenticeship scheme, theoretical studies and planned practical work must be complementary.

Recipients of prizes and certificates were as follows:—

Final Year.—E. L. Hassell (B.Sc., 2nd class hons.).

Fourth Year.—J. Cownie (degree course), A. Creak (Higher National Certificate).

Third Year.—B. Campion (B.Sc., 2nd class hons.), A. Gibbs (degree course).

Second Year.—G. Jones (degree course), P. Jeffray (Ordinary National Certificate, distinction in all subjects).

First Year.—K. Noble and A. Lynne (degree course).

Special Prize (for good work by a trade apprentice, *now* up-graded to technical apprentice).—E. Martin.

Certificates (on completion of five years' apprenticeship).—R. Hassell, D. Brown, P. Burton, G. Harrison, J. Rowles, E. Berg, C. Yeowart.

NEWS of the WEEK

ROLLS-ROYCE HILLINGTON PLANS

AS we briefly announced last week, the stepping-up of Canberra production (at the factories of four companies) will mean a corresponding increase in the output of the powerful axial-flow Avon turbojet, and Rolls-Royce, Ltd., are to be assisted by the Bristol and Napier concerns.

Both at Derby and at Hillington (Glasgow) the Rolls-Royce factories themselves will be engaged on the new programme. This will be the first occasion on which jet units have been built in Scotland. During the peak of war-time production the vast Hillington works employed 24,000 workers; the present pay-roll is 4,300. The increase now visualized is undisclosed, but Mr. J. D. Pearson, general manager of the Company's Aero division, has stated that it will "be reckoned in thousands rather than in hundreds."

Speaking at the annual dinner of the Foremen's Club at Hillington, Mr. Pearson said that the new project was not "something which could start to-morrow"; much planning would be necessary, there was the main problem of obtaining the necessary machine tools, and it would be impossible to obtain sufficient skilled labour—for which reason an endeavour would be made to install equipment that could be used by semi-skilled workers.

The factory would also have to continue its present work on Merlin engines and, in fact, would have to take an increasing share of this load from the Derby works.

OBITUARY

IT is with regret that *Flight* records the death of Sir Gurunath Venkatesh Bewoor, B.A. (Bombay and Cantab), K.C.I.E., I.C.S., who had been managing director of both Air India International, Ltd., and Air India, Ltd., since 1948.

Sir Gurunath had been well known as an administrator in several Indian Government departments since the early thirties and in 1944 was Indian delegate to the I.C.A.O. Conference in Chicago. From 1942 to 1946 he acted in the capacity of Secretary to the Post and Air Department of the Indian Government; he was also a member of the U.N.O. Transport and Communications Commission.

We also regret to hear of the death, after a long illness, of S/L. H. R. Bunn, who has contributed a number of articles to these pages. "Bunny," as he was known to all his friends, served for 21 years in the R.A.F. and was among its most experienced Engineer Officers. Though his technical knowledge was of an all-round character, he was particularly expert in aircraft maintenance, its planning and its economics, and he also specialized in the mechanics, both theoretical and practical, of parachuting. After his retirement from the Service he was successively with Flight Refuelling, A.S.T. and Sperry's: he was concerned with the last-named company's technical publicity at the time of his death.

HAWKER OLD-TIMERS CELEBRATE

EARLY days of aircraft construction at Kingston-on-Thames were recalled last Friday evening when 123 members of the firm of Hawker Aircraft, Ltd., were presented with clocks in recognition of periods of service exceeding 25 years. The ceremony was one of the series that has been taking place throughout the various factories of the Hawker-Siddeley Group.

As Mr. A. N. Spriggs, O.B.E. (works director) reminded those present, it was on November 15th, 30 years ago, that the H.G. Hawker Engineering Co. started operations—actually, the manufacture of motor cycles—in the disused skating-rink which still exists next door to the big works near Kingston Station. The making of aircraft components soon followed, then design of a complete machine—the Hawker Duiker, which flew in 1923. Since then, 60 distinct types and another 40 sub-types had emerged, powered by engines from 14 different manufacturers—and all of them were the brain-children of Mr. Sydney Camm, C.B.E., F.R.Ae.S., director and chief designer.

Mr. Camm himself recalled the 80 m.p.h. Hawker Cygnet of 1925, with its wing loading of 4lb/sq ft and contrasted it with the loading of modern jet aircraft, which often is more than ten times higher.

Messrs. Spriggs, Camm and E. H. Jefferson (who is responsible for quality control) having presented 120 clocks—no mean feat of endurance—they themselves received the remaining three, from the hands of various "oldest inhabitants." Then, with the canteen piano at full boost, and Mr. George Anderson (i/c sales and publicity) as an efficient M.C., the celebration continued in a style appropriate to the occasion.

TWO LONDON PARTIES

MANY members and guests of the London Aeroplane Club attended a most enjoyable annual ball held at Londonderry House last Friday. Several rooms in the attractive mansion were open for refreshments and provided a pleasant atmosphere for friendly meetings and shop talk, while elsewhere there was dancing and a cabaret.

On the following evening the Dorchester Hotel was, as usual, the scene of the Pathfinder Association's annual ball. This most active and successful of organizations once again provided a delightful party for its members and their guests. *Flight's* bouquets go to the organizers—and especially to the Dagenham Girl Pipers, whose spirited performance and eightsome-reel finale exactly suited the occasion and the mood of the guests.

A C.-in-C. AMONG THE MODELLERS

TARDILY, perhaps, Higher Authority has now recognized the value of aircraft model-making and flying in fostering aviation enthusiasm and knowledge among the young people of the country. This fact was reflected by the presence at the annual dinner and dance of the Northern Heights Model Flying Club in London last Saturday of Air Marshal Sir Hugh P. Lloyd, K.B.E., C.B., M.C., D.F.C., A.O.C.-in-C. of Bomber Command. Also among the guests were A. Cdre. J. F. Titmas, C.B., C.B.E., Senior Technical Staff Officer, Bomber Command, and A. Cdre. North Carter, C.B., D.F.C., Commandant of Halton. Undoubtedly the "senior pilot" of those present was Maj. S. V. Sippe, who was one of Britain's outstanding aviators before the First World War and was a pioneer seaplane pilot.

Sir Hugh, who is president of the rapidly expanding R.A.F. Model Aircraft Association, told N.H.M.F.C. members how, on returning from the Middle East earlier this year, he had made his first acquaintance with modern model-flying: he confessed that he was most intrigued, and from then on had "had it"—in the most complimentary sense of the term.

Lady Lloyd presented an impressive array of prizes as a preliminary to several hours of jollification under the benevolent chairmanship of the ever-enthusiastic Dr. A. P. Thurston—who, incidentally, announced amid cheers that Hawker Aircraft, Ltd., had promised him the use of Langley Airfield for the Club's annual gala day for as long as it remained in their possession.

METEOROLOGICAL YEAR

THE recently published annual report of the Director of the Meteorological Office presents a concise picture of the department's wide field of activity. Although the major part of met. work is, of course, directed towards meeting the everyday needs of various sections of the community—such as civil aviation, the Services, industrial concerns and public utilities—the report reveals something of the rapidly expanding programme of research into forecasting problems which was instituted during the year.

The report enumerates the studies which are being made, using radar methods and aircraft equipped with special instruments, of the physics of clouds and size of cloud droplets. Other investigations include the sampling of air at high altitudes and the study of high-level turbulence and the effects of weather on the visibility of airport approach lighting. At the geophysical observatories of Kew, Eskdalemuir and Lerwick, records are maintained of the standard meteorological elements, radiation, terrestrial magnetism, atmospheric electricity and seismic movements.

In view of the loss of Airmet, there is interest in the mention of the service—an innovation during the year—by which a daily television broadcast is made of meteorological charts and forecasts covering south-eastern England and the Midlands.

Constant liaison, says the report, was maintained with other countries through the medium of I.C.A.O. and international meteorological organizations.

The report is obtainable from H.M. Stationery Office at 1s 3d.

NEW DESOUTTER DRILLS

NEW two-speed portable electric drills of ¼in and ⅜in capacity in steel have been added to the extensive range of portable equipment made by Desoutter Brothers, Ltd., The Hyde, London, N.W.9.

The construction is particularly robust with a view to a wide field of use in and about workshops, and with carbide-tipped tools the new models are, it is stated, equally effective for drilling concrete and masonry. Prices compare favourably with those of orthodox single-speed tools of similar capacity.

AVRO

ASHTON

FINDING THE ANSWERS
to to-morrow's problems.

Of the new Avro research aircraft, the Ashton series has been specially developed to investigate the problems of high-altitude jet operation.

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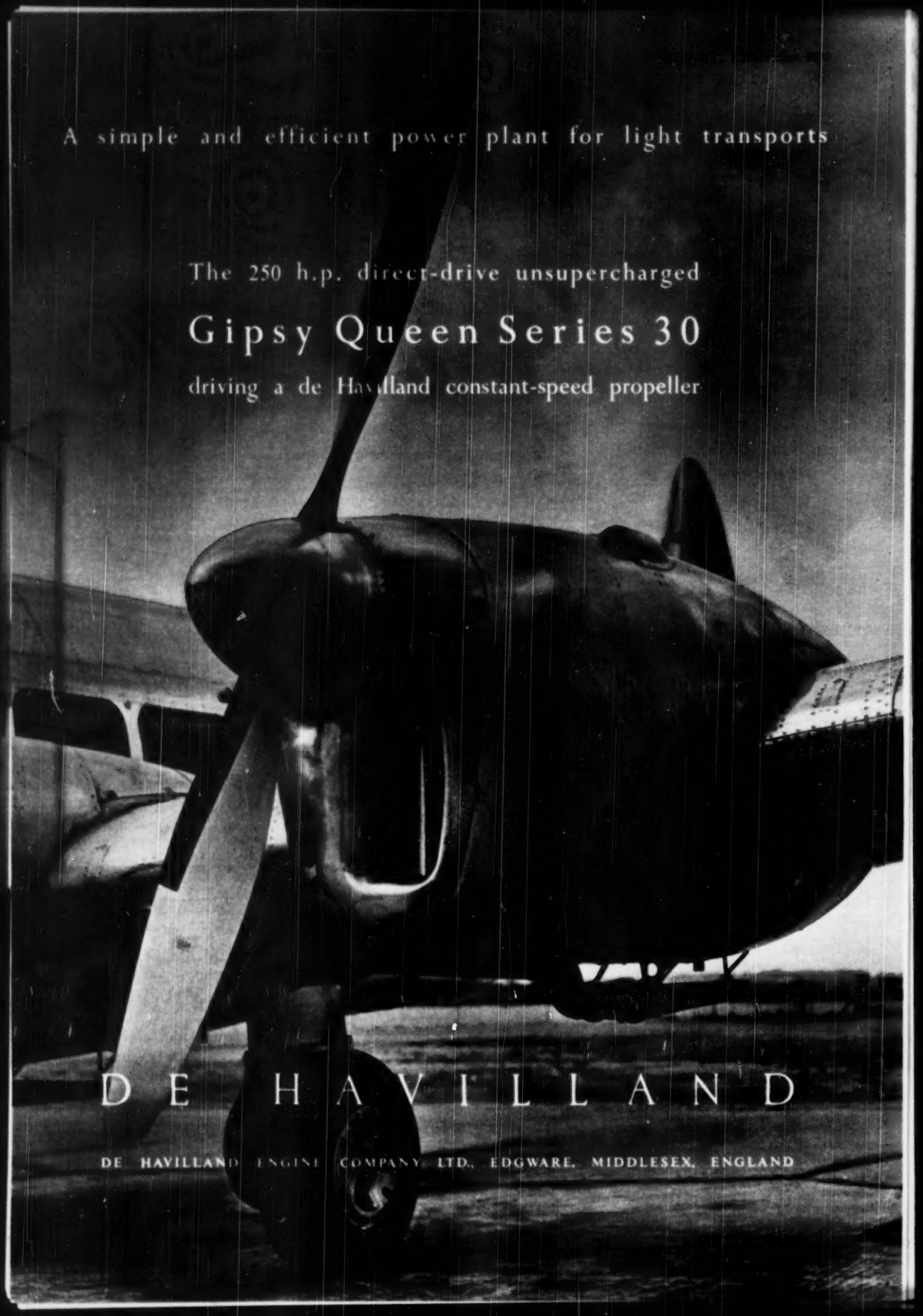
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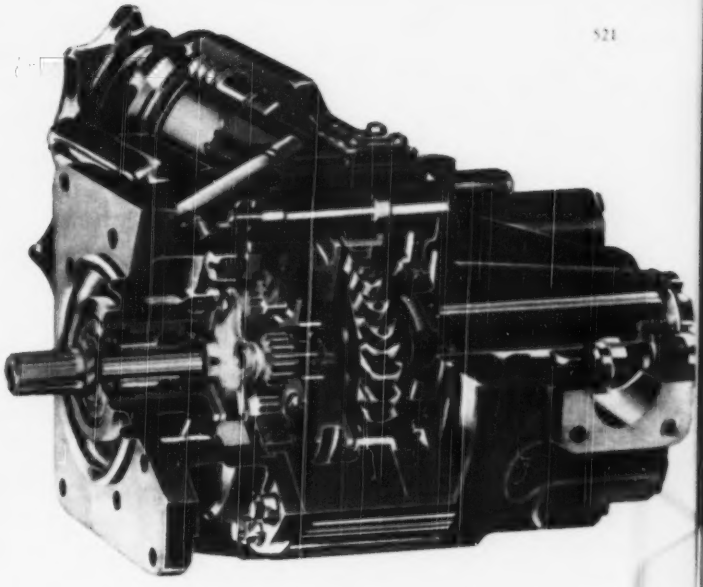
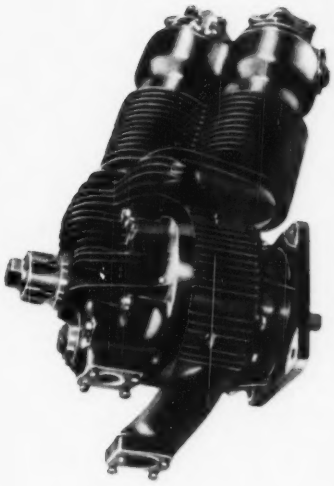
A NEW BRITISH TURBO-STARTER

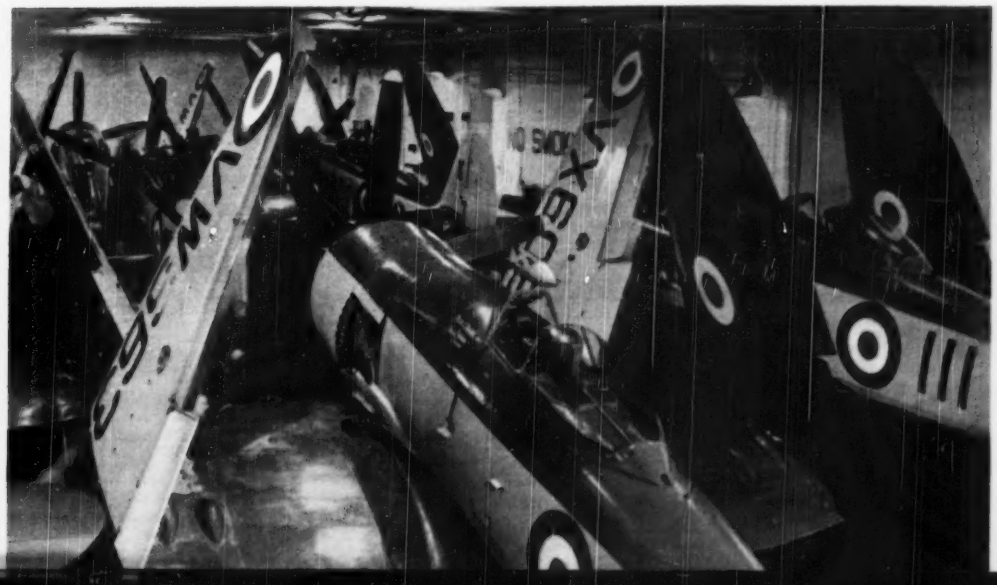




THE accompanying photograph and cut-away illustration show the external appearance and the internal details of the Rotax CT 0101 gas-turbine starter. This component is the first turbo-starter for gas turbine power units to be fully approved. Two controlled-burning cordite cartridges are employed, but the second can be fired only when the first is spent, the cockpit switch being arranged accordingly. Gases pass through four ports from the rear chamber, expand across the turbine, and are then exhausted to atmosphere. The turbine drives the sunwheel of an epicyclic reduction gear, the annulus of which is restrained by an overload clutch; the planet carrier is on the output shaft. Data are as follows: output speed, 9,000 r.p.m.; output torque, 100 lb-ft; maximum power, 170 b.h.p.; duration, 3.2 secs; clutch setting (break-away) 180 lb-ft; weight, 60 lb; maximum operating temperature, 45 deg C.

CHEEK-BY-JOWL : BELOW DECKS IN A CARRIER

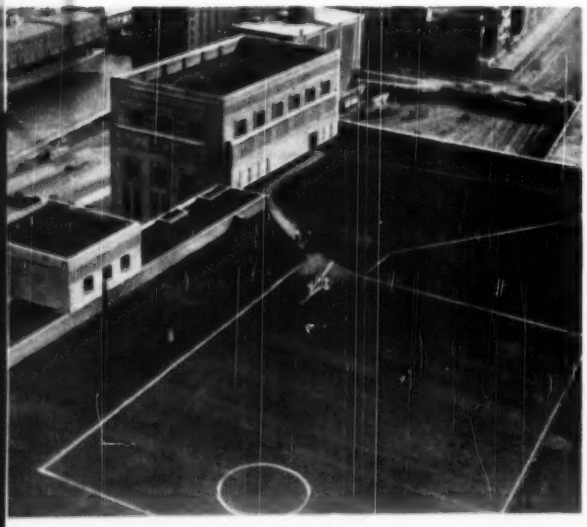
Indicative of the restriction in a carrier's hangar is this recent view, secured aboard H.M.A.S. Sydney, the 13,190-ton vessel purchased from Britain some eighteen months ago. The Hawker Sea Furies seen belong to the Australian 21st Air Group.



Carrying a load of airmail, a shuttle helicopter beats its way through the industrial murk over Chicago's rooftops en route from its Midway Airport base to the city's general post office. This flight is made 18 times daily and takes ten minutes as compared with forty by road.

CHICAGO HELICOPTER MAIL

Conspicuously devoid of the paraphernalia typical of ground airports, this heliport is situated on the roof of the city's main post office.



Serving Forty-three Suburbs : Successful First Year of Operation with Six Bell 47Ds

THE introduction of helicopter mail services in the Chicago area is said by the U.S. Post Office authorities to have almost doubled the use of airmail by residents of the city and of the 55 nearby communities to which the service provides links. From this fact alone, to say nothing of the often remarkable speed with which postal deliveries can now be effected, it is obvious that the service has more than justified its existence.

The operating company in question—Helicopter Air Service, Inc.—recently completed its first year of operation over a network which includes a shuttle route, between the Midway Airport and the roof of the Chicago general post office, and three routes to 43 suburban communities.

During this first year 95.48 per cent of scheduled flights were completed—all without serious mishap; a total of 280,430 miles were flown and some 2,190,790lb of mail were carried. The day's operations begin at about 6 a.m. and continue until 8.30 p.m., by which time a total of 1,200 miles has been recorded.

It would be an understatement to say merely that this method of picking up mail has proved "popular." The enthusiasm of one satisfied customer can only be imagined: having posted a special delivery letter at 10.30 a.m. in a Chicago suburb, he was delighted to find that it had actually been delivered 1,400 miles away in Miami by 7.30 a.m. the next day.

In some communities in the area the use of airmail is

Rapid turn-round times are one of the key features of the service. Mail is loaded into the fuselage panniers with the engine still running.

Additional stowage is provided for mail-bags in a special compartment beside the pilot. The Bell modified 47Ds will carry 533 lb of mail.

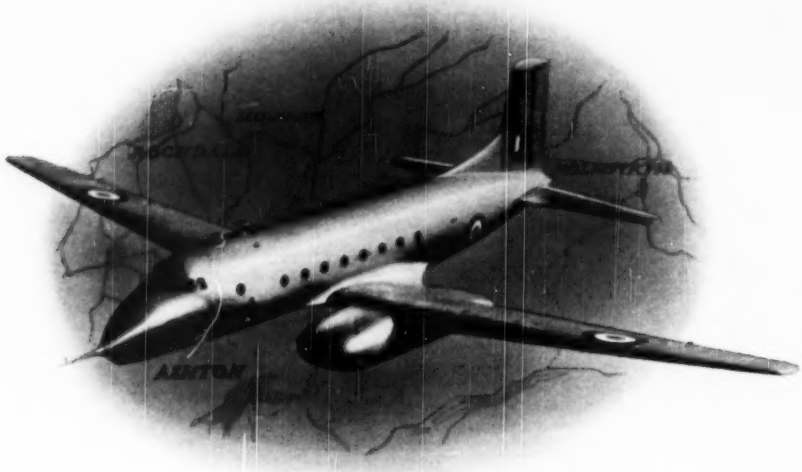
said to have increased by 300 per cent in the last year. In Aurora, Illinois, for example, it rose from 715lb in January to 3,309lb in June, while deliveries from Midway Airport to the suburbs increased from 15,424lb to 21,767lb during the same period.

The shuttle route from Midway to the general post office, a round-trip distance of 18 miles, is flown 18 times daily. Suburban routes, one of them of 106 miles and the others of 102 and 89 miles respectively, are flown three times daily. At these stopping-points the helicopters land in fenced-off areas located as close as possible to the local post office. The elimination of taxying and time-consuming ground-handling enables the helicopters to achieve, in most cases, a turn-round time which does not exceed a few minutes.

The Bell 47Ds used by H.A.S. have been lifting up to 343lb of mail, but modifications are now in hand to power them with 200 h.p. Franklin engines (instead of the 178 h.p. Franklins now used) which will permit a 55 per cent increase in this load—to 533lb. The company is also proposing to introduce night operations when crews have acquired sufficient experience.

This small heliport is typical of the landing areas provided at suburban stops. Forty-three suburbs are served by a total of nine flights daily.

To co-ordinate arrivals of aircraft and reception parties at suburban stops all helicopters are in radio contact with Midway Airport.



AVRO ASHTON

A Review of the Prototype Multi-jet High-altitude Test Aircraft

AIRCRAFT performance is a complex of several factors which can be sifted out to a synthesis of speed, height and endurance. Each of these is, of course, interdependent with the other two, and according to the duty of the aircraft so will the accent upon the factors change. For a fighter, speed and height—and their derivatives, rate of climb and time to height—are emphasized at the expense of endurance. For a bomber, speed and endurance usually take some precedence over height, whilst with naval and patrol aircraft endurance is the more usually pre-eminent. These, of course, are generalities which can easily be disproved by particular instances, but as broad postulates they stand fairly firm.

Nor is there any marked diversion when the proposition is applied to commercial airliners. Certainly, the accent upon the individual factors changes according to the destined rôle of the machine, but, broadly, every operator wants an aircraft which will travel between A and B as fast as, if not faster than, the types used by his competitors; and, as there is economy in altitude, the general demand is for the highest operating altitude compatible with route length. Fuel economy is, of course, tied up with altitude; and as the gas turbine, unlike the piston engine, is more economical the higher it flies, the emphasis on altitude is becoming as pointed in the commercial field as it is (for somewhat different reasons) in the military field.

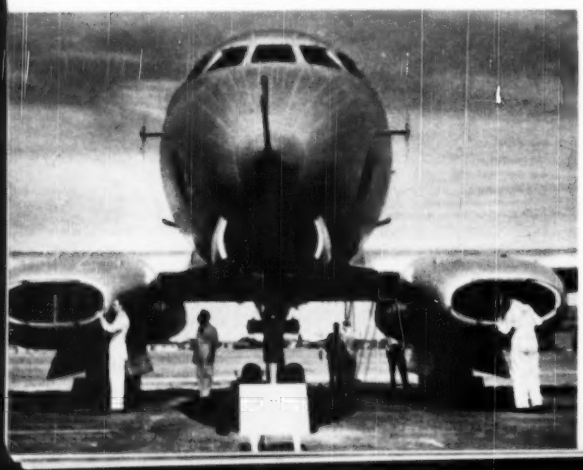
Most first-line fighters to-day have the ability to operate at 40,000ft and over; when the new jet bombers arrive to supplement the Canberra they, too, will be able to get along at between 40,000 and 50,000ft, if not even higher. As to commercial aircraft, the Comet is designed to operate at between 35,000 and 40,000ft. Thus, with some concrete evidence for justification, it can be inferred that altitudes of the 40,000 to 50,000ft order, already common to many aircraft, will within the coming years be general operational heights for most types other than light personal aircraft, heavy transports and short-range feeder-liners.

The very fact that so many aircraft already flying can attain these altitudes is apt to lead the casual observer into assuming that the problems of high-altitude operation are solved. Such an assumption is far from being true. At the present time, we are only beginning to explore the field and an enormous amount of investigation still has to be done before aircraft can be fitted for operation at great altitudes with complete safety and comfort. In this connection, it should be remembered that what may be justifiably acceptable as a military expedient may well be hopelessly unfitted to everyday commercial practice. Even so, there is a great deal still to be learned about the operation of military aircraft at high altitude: thus the problems are broadly fundamental, although the specific solutions may differ according to the needs of fighting and peaceful ends.

Necessarily, whilst much development work of a preliminary nature is most efficiently and economically conducted in laboratories, wind tunnels, decompression chambers and refrigerators, the ultimate test of behaviour can be derived only from full-scale operation in factual conditions. To this end, a palpably essential research tool is an aircraft capable of attaining at least 40,000ft, whilst being large enough to accommodate test equipment, automatic observers and research personnel, aside from the flight crew. In addition to all this, it is necessary that it should have sufficiently advanced speed performance and endurance to make possible flights of worthwhile duration. Such an aircraft is the Avro Ashton.

Seen for the first time in public at the S.B.A.C. show at

This imposing view of the Ashton was taken at the S.B.A.C. show. Note the flat glass panels in the curved framing of the cockpit screen.



Farnborough in September, the Ashton gives the appearance of being a modern multi-jet passenger aircraft. Powered by four Rolls-Royce Nenes, paired in twin nacelles, and with a roomy fuselage of 11ft diameter, the prototype Ashton is, in fact, the first of a series of six high-altitude research aircraft, each of which will be equipped (and modified as necessary) for application to individual fields of investigation.

The fuselage is a semi-monocoque of circular section and entirely orthodox construction, but on the pressurized nose is carried a faired false-nose which, in that it merely accommodates the nosewheel when retracted, is unpressurized—an entirely satisfactory and simple solution to the problem of pressure-sealing the awkward shapes of retraction wells. Crescent diaphragm-ribs and top-hat stringers carry the skin of the false nose, the fore-part of which is extended to a needle-like proboscis incorporating a pitot head and yawmeter. These, however, comprise a test installation for the prototype flight trials, and will not be embodied as a permanent feature.

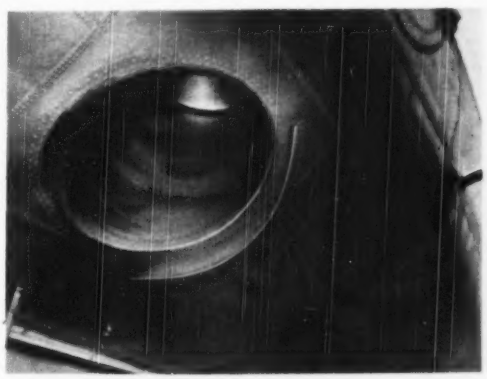
In order to provide comfortable working conditions for the research personnel—as well as, *ipso facto*, to glean data on the subject—the fuselage is pressurized to a differential of 8.2 lb/sq in, whereby an 8,000ft altitude pressure-equivalent is given at an actual altitude of 40,000ft. This differential is provided by two-stage supercharging. Each pair of Nenes jointly drive a Rolls-Royce auxiliaries gearbox, and on each gearbox is mounted a 30 lb and a 15 lb Roots-type Godfrey cabin-blower. Each 30 lb unit runs at 0.544 engine speed, and delivers its output to its associated 15 lb unit, which runs at 0.696 engine speed. Below 7,000ft, however, the full two-stage delivery is not required and, therefore, by-passes are fitted so that the output of the 15 lb blowers is not used until 7,000ft is exceeded. With so much compression energy available, the inherent heating is ample to keep the cabin at a comfortable temperature even when the aircraft is flying at its operational ceiling. For work in unwontedly low ambient conditions, however, the blowers are throttled so that the increased back-pressure amplifies the inherent heat generation. The fuselage interior is lagged with a double layer of insulating glass-wool blanket, each layer being of $\frac{1}{2}$in nominal thickness.

One of the structural design details attendant upon the use of so high a pressure differential is that no Perspex glazing used in the Ashton is drilled or rebated. As no sudden changes of section exist, the known mechanical properties of the panels can be relied upon. The window panels of Perspex are held in rubber channel-section surrounds, and retained by curved clamps of flat-section spring steel, through-bolted to the window-frame structure. In the case of the pilots' glazing, a somewhat different system is used. The framework is an assembly of light alloy castings, and was designed originally for panels of curved glass; difficulties in the manufacture of curved panels of toughened glass, however, have led Avros to employ $\frac{1}{2}$in-thick curved Perspex for the centre panel, this being flanked by flat glass panels to provide undistorted view and permit the use of windscreen wipers. The next panels port and starboard can be opened to provide direct vision, and rearward of these are curved panels, of $\frac{1}{2}$in-thick Perspex. The flat glass panels are Triplex three-ply units, the outer lamination being annealed plate glass, which is separated from the inner lamination of toughened glass by an interlayer of Vinal, 0.12in thick. This interlayer has a 1in selvedge, which is bonded to a light alloy reinforcing strip, through-bolted with a clamping ring and rubber seal to an adaptor frame, whereby the flat panel of glass can be accommodated within the contours of the main framing.

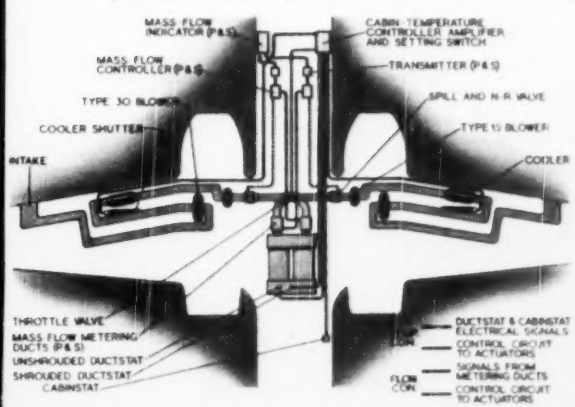
There is nothing out of the ordinary about the flight-deck layout beyond, perhaps, a certain spaciousness which is apparent rather more in the accommodation of the flight engineer, navigator and radio officer than in the cockpit proper. Although, in practice, they may well use the main entry door on the port side of the rear fuselage, the crew are provided with a separate door which opens from a "vestibule" at the starboard side of the flight-deck, abaft the engineer's station. In the floor of the vestibule is a circular tampion hatch—or "manhole"—beneath which is a 24in-diameter escape tunnel for baling out. A small deflector around the leading edge of the tunnel outlet gives transient protection from airflow, and the hatch itself seats on a rubber inflatable seal for pressure-retention.

The main volume of the fuselage is free space, in which all sorts of combinations and permutations of research equipment may be installed, according to the particular needs of a given line of investigation. In the prototype Ashton, at the time of our inspection, there were simply two automatic observers set up in the fore part of the cabin

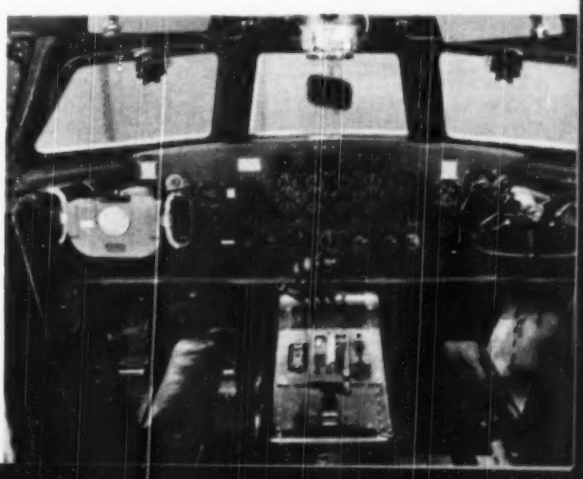
(*Continued after double-page drawing of Ashton*)



This schematic diagram illustrates the relationship of the control system for the all-important cabin pressurization and conditioning.



(Above) A parachute exit in the form of a 24in-diameter tunnel is embodied. (Below) The cockpit is neat and uncomplicated. The captain's controls on the prototype incorporate a "stick-force" unit.

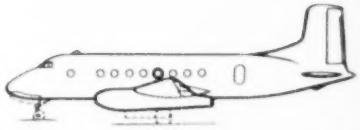


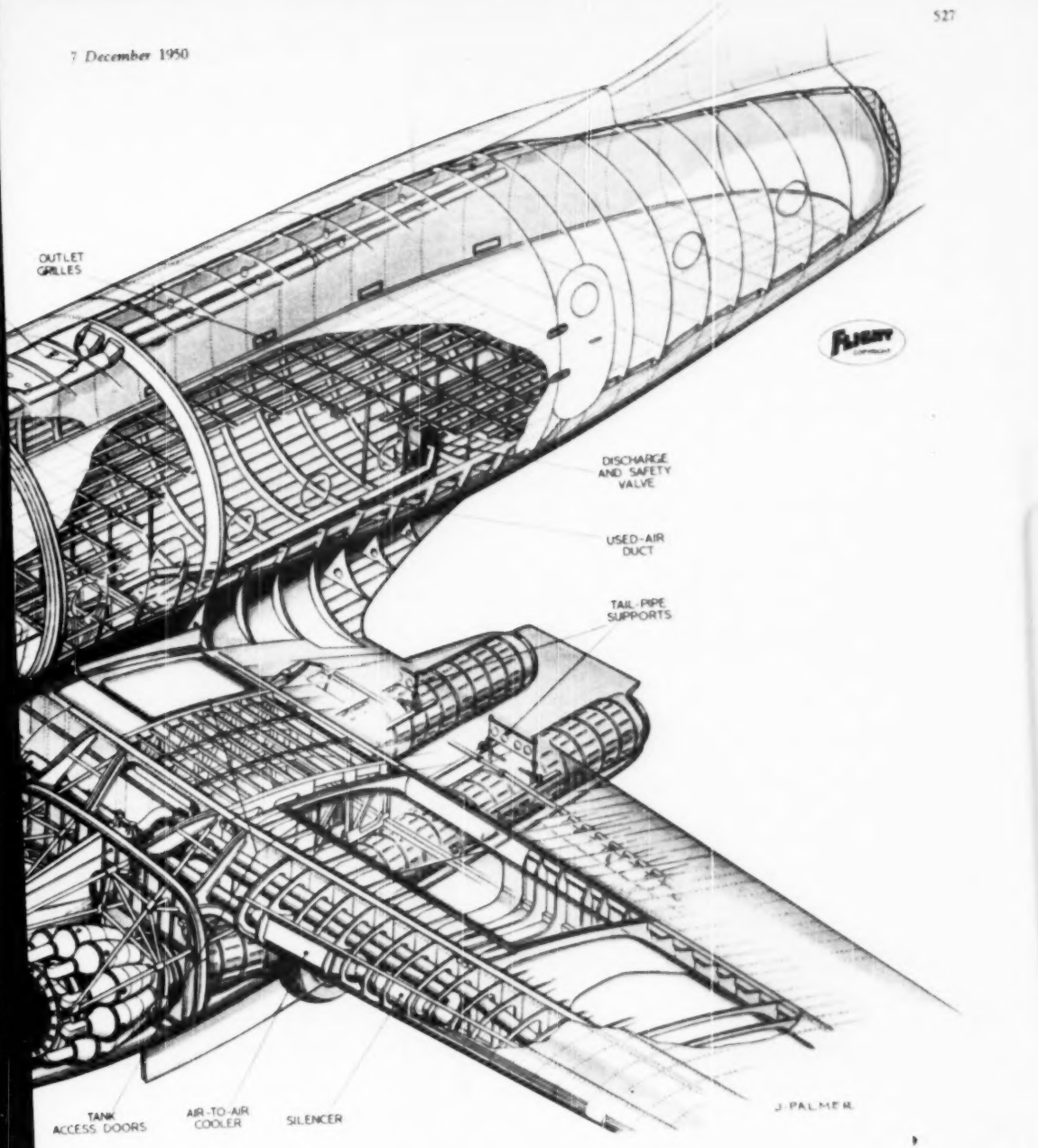
Avro ASHTON

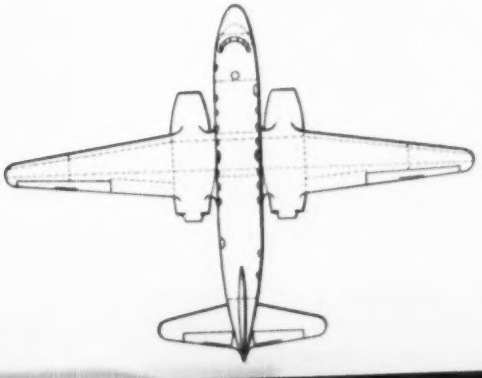
AVRO ASHTON DATA

Four Rolls-Royce Nene turbojets each of 5,000 lb static thrust.

Span	120ft	Dihedral	4 deg 0 min
Length	89ft 7in	Incidence	4 deg 0 min
Height	30ft 9in	Taper ratio	32.8 per cent
Wing area	1,421 sq ft	Tailplane span	43ft
Aspect ratio	10.13	Tailplane and elevator area	332.6 sq ft
Aerofoil section, root	N.A.C.A. 23018	Fin and rudder area	216.22 sq ft
tip	N.A.C.A. 23007	Gross weight	82,000lb
Standard mean chord	11ft 10in	Maximum landing weight	74,000lb
T/c ratio, root	18 per cent	Wing loading	57.6lb/sq ft
tip	7 per cent	Span loading	684lb/ft




OUTLET GRILLES
DISCHARGE AND SAFETY VALVE
USED-AIR DUCT
TAIL-PIPE SUPPORTS
TANK ACCESS DOORS
AIR-TO-AIR COOLER
SILENCER
J. PALMER



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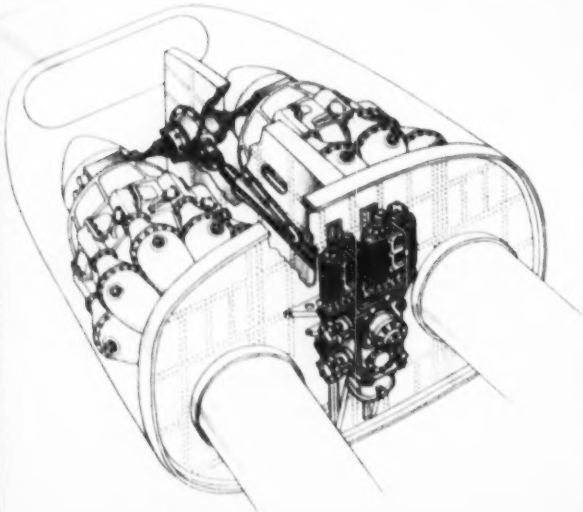
on the port side. These, however, are test installations for use in the flight trials of the aircraft itself.

One of the detail-design difficulties associated with the high-altitude flight of the larger types of aircraft fitted with full cabin-conditioning is the effects of differential thermal expansion on control transmission systems. Above the tropopause, the ambient temperature by I.C.A.O. definition is —55 deg. C, and when soaked for even a relatively short space of time at this low temperature level the airframe structure is bound to contract to some extent. By contrast, the fuselage interior might be heated to, say, 10 deg. C, and, because the control linkages for rudder(s) and elevators have to run virtually the whole length of the fuselage, large amount of sloppiness may develop in the controls. It is in establishing solutions to just such problems of practical design that the Ashton will undoubtedly prove to be extremely useful. The control transmission used is a conventional push-pull tube and treble-roller-guide system: a similar method is employed for trim control, but with the difference that the penultimate linkage is by means of racks and pinions with screw-jacks finally driving the tabs. All control surfaces are additionally furnished with balance tabs.

Wing construction follows established Avro practice with extruded-boom and plate-web front and rear spars and contoured chordal ribs. Each wing embodies a tunnel for accommodation of the four flexible-bag-type tanks, port and starboard. In this connection, whilst the four port tanks normally feed the port engines, and the four starboard tanks the starboard units, a cross-feed cock can be actuated, if necessary, to feed all four engines from one side. Each fuel tank is fitted with an electrically operated pump, and flow to the power units is governed by a low-pressure service cock in each supply-line. Other than a drain-valve which is manually operated on the ground, all fuel cocks are electrically actuated and are controlled by the engineer.

As already noted, the Ashton's four Rolls-Royce Nenes are arranged in pairs in twin nacelles. The power units are carried, together with the firewall and the fore-and-aft dividing diaphragm, on a triangulated tubular structure, cantilevered off the front spar. In plan, the Nenes are "toed-in" so that their thrust axes form a vertex angle of 13 deg., and in side elevation are cocked nose-up at an angle of 4 deg. 30 min. Individual power units in each pair are united by a cross-drive from their wheelcases to a common bevel box carried in the front of the dividing fore-and-aft diaphragm, and a drive-shaft from the bevel box extends rearward in a duct formed in the diaphragm to provide power input to an accessories gear box behind the firewall.

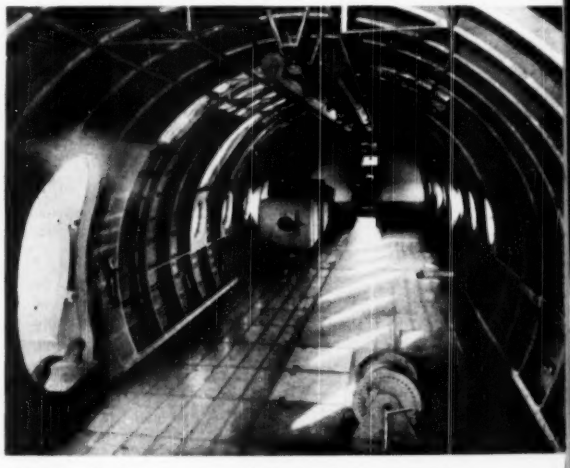
The accessories gearbox is mounted on the rear of the transverse firewall and is jointly driven from each wheelcase of the Nene turbojets.



The port gear box serves a 15 lb and a 30 lb cabin supercharger, a Dowty hydraulic pump and two Hymatic compressors; the starboard gear box serves similar blower units, and two Dowty pumps, but is not fitted with Hymatic compressors. A six-kilowatt generator and suppressor is mounted on the nose of each engine wheelcase, and is faired by a light-alloy conical-shroud embodying generator-cooling ducts.

As the thrust axes of the Nenes are skewed, adaptor joints are necessary at the "elbows" between the engine jet-pipes and the extension tailpipes which run truly fore-and-aft. The length of the extension pipes—17ft from elbow to orifice—means that the static back-pressure is relatively high, so a bleed-valve is embodied in the elbow-joint adaptor to permit ease in starting. The tailpipes are not lagged, and are carried at the rear on swing-links which permit axial expansion. Some degree of aerodynamic advantage is to be expected from the extended nacelle-fairing, which projects some few feet rearward of the wing trailing-edge.

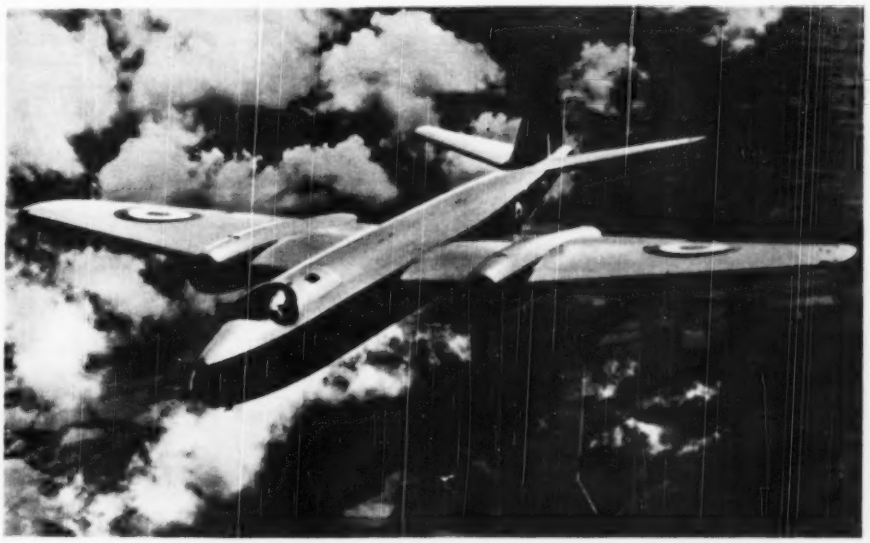
To revert to auxiliary services, undercarriage retraction, flaps actuation and nosewheel steering are powered by a Dowty live-line hydraulic system, the cockpit controls for which are respectively twin push-button switches for the undercarriage, a six-position lever switch (in conjunction with a drum switch) for the flaps, and a graduated tiller unit for nosewheel steering. Undercarriage extension is by gravity, only the up-locks being released by hydraulic means. Should the hydraulic system fail, an emergency air system can be brought into operation to release the undercarriage up-locks, assist in initial extension of the undercarriage jacks, and actuate the flaps. The compressed air for the emergency system is stored in two 2,000 lb/sq in ground-charged bottles.



(Above) The fuselage interior is amply spacious for the accommodation of a great deal of research equipment. (Below) With the nacelle tail-fairing removed, the "cool-chamber" separating the jet-pipes is accessible, whilst the pipes themselves are easily removable.

PROGRESS

Rolls-Royce produce turbo-jet,
propeller-turbine and piston aero engines to suit
all types of medium and high-powered aircraft



THE ENGLISH ELECTRIC "CANBERRA" BOMBER
powered by two Rolls-Royce "Avon" turbo-jet engines

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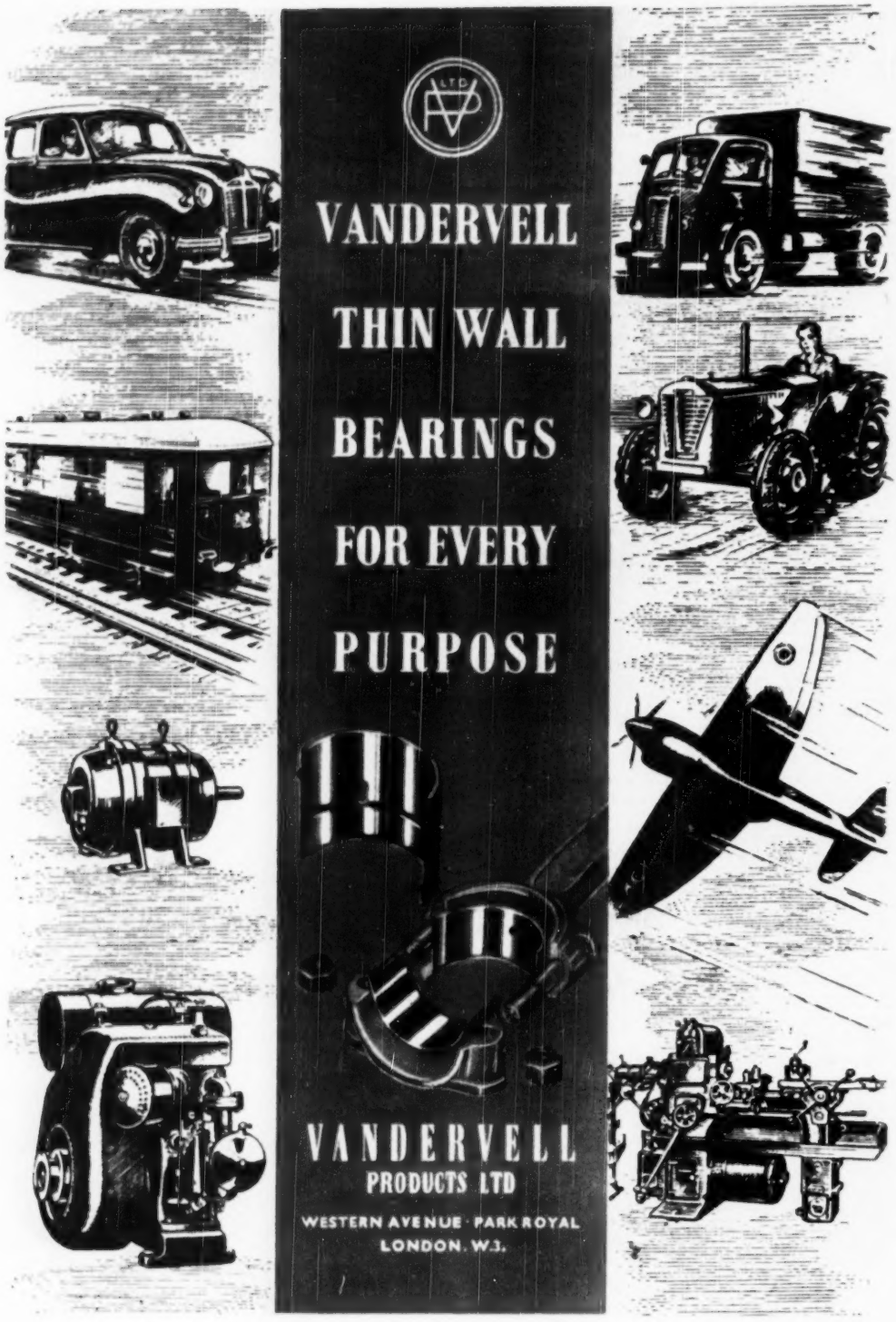
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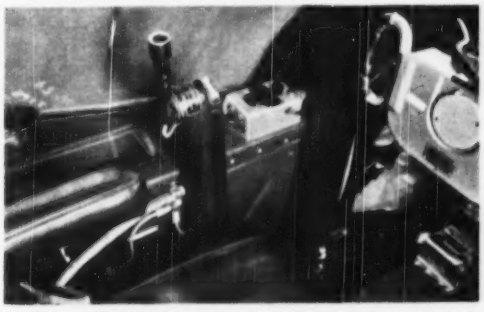
The pneumatic system employs the Hymatic compressors to charge a pair of storage cylinders which supply air for operation of the double-inflation-bag wheel brakes, for pressurizing the hydraulic reservoir and the windscreen de-icing tank, and for pressurizing water delivery to the crew's toilet.

Power supply for the electrical and radio services, and also for the four 12v 60a.h. accumulators—which are wired in series/parallel—is derived from the four 24v 6kW generators carried, as already mentioned, one on each engine wheelcase. Voltage control is governed by Type 23 regulators, line voltage being maintained at 28 by a master regulator. The single-pole wiring system utilizes the airframe structure as a negative return, and comprises Prentype cables with S.B.A.C. connection blocks at break-down points. A ground/flight switch is under the control of the flight engineer. The radio officer has H.F./M.F. main and auxiliary installations, Marconator radio compass, and Rebecca Mk. 2 V.H.F. radio telephony; Controllable Beam Approach systems are pilot-operated. The main power switch for control of all radio and radar supplies is fitted at the engineer's station. Conversation in flight is effected through a Bendix intercommunication system.

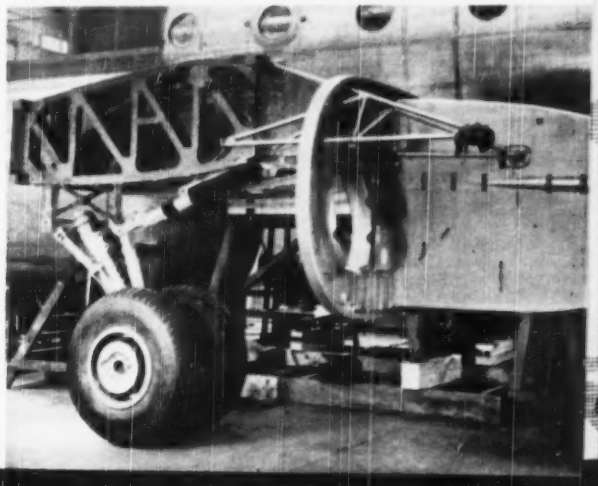
Economy is not normally a quality associated with research aircraft, but because it was thought scarcely worthwhile to design an entirely new undercarriage for a production of only six Ashtons (and, too, to provide some commonality with existing R.A.F. stores) the decision was taken to make use of Hermes/Hastings main undercarriage units designed and manufactured by Electro-Hydraulics, Ltd. Owing to the small overall height of the undercarriage leg proper, the strut crosshead is pivoted in a pair of massive verticals, machined from the solid, and bolted on the front face of the rear spar with cross-bracing below the bottom boom between the dependent arms. On the rear face of the front spar, and about the vertical centre-plane of the wheel well, are a pair of machined-bar verticals, between the tops of which is anchored the undercarriage jack; the head of the radius breaker-strut is anchored at the base of the verticals just above the bottom boom of the front spar. The jack-rod picks up in a forged strap-fitting around the radius strut, about 2ft above the knuckle joint. Initial movement of the jack for undercarriage retraction withdraws the down-lock latch, which conversely (and owing to the fact that the undercarriage is lowered by gravity) is extended to secure the down-lock by means of a coil-spring; this last is housed in a telescopic casing carried on, and parallel with, the upper part of the breaker strut. The up-lock incorporates a spring-cum-single-acting hydraulic jack, the spring actuating the lock to hold the latch in the extended position, whilst the jack withdraws the latch to permit the leg to lower: a striker lever for the micro-switch is carried on the latch. The undercarriage doors are mechanically linked to the breaker strut.

By contrast with the simplicity of the main undercarriage arrangement, that of the nose undercarriage is relatively complex. This does not apply so much to the leg itself—although the steering mechanism complicates the structure—but rather to the elaboration involved in the fairing-door arrangements. Nominally, the leg is a straightforward telescopic strut, designed and manufactured by Dowty Equipment, Ltd., and employing a liquid-spring shock-strut. The head of the leg is retained between the front and rear webs of a cross-beam, from the outboard ends of which machined side-bracing struts extend down to pick up lugs on a forged band-fitting around the upper half of the leg. At the outboard ends of the cross-beam are stub-axles which engage plain bearings embodied in machined fittings bolted to the diaphragms which form the walls of the retraction well. Just below the leg head, a forged bracket is bolted on the rear side, and forms the attachment point for the retraction jack-rod. The jack itself is anchored to the upper lugs of a machined fitting carried on a transverse diaphragm, and to the lower lugs of this same fitting the head of the radius breaker strut attaches. This is not a breaker strut of conventional arrangement, for it is broken when the undercarriage is down, and extended when it is up: the down-lock is embodied at the knuckle joint.

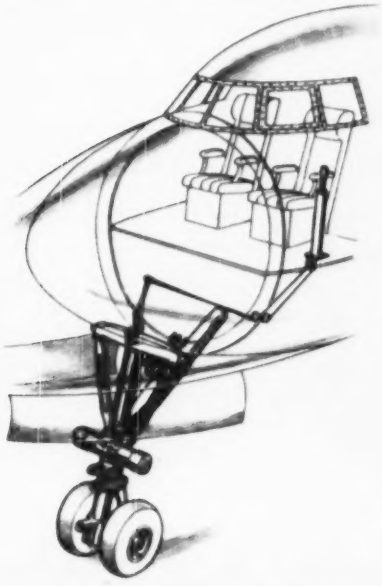
The steering motor is anchored to the band-fitting which encircles the upper half of the leg, and consists of a transverse cylinder in which floats a drum-type piston. Across the centre of the latter is a diametral pin which projects out through an axial slot in the cylinder wall. In the interior of the piston is a pair of coil springs, separated by a free-



(Above) The nosewheel steering tiller is convenient to the captain's left hand. (Below) Structural detail of wing centre-section, main undercarriage, engine mounting, transverse firewall and dividing diaphragm.



Detail of the transmission linkage from captain's tiller to the hydraulic steering motor, carried across the front of the nosewheel strut.



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floating block with a slotted hole through it for accommodation of the diametral pin. At their outboard ends, the coil springs bear against discs, from which extend short rods, passing through the end-walls of the piston with glands for oil retention. Pressure oil to one end or other of the cylinder will move the piston appropriately, the motion being transferred to the steering linkage through the medium of the diametral pin. When the piston travels beyond a certain point, however, the appropriate rod will butt against the end-wall of the cylinder, and further motion of the piston will then result in compression of the springs, division of load being transferred through the central block: by this means, self-centering action is achieved.

The projecting end of the diametral pin transmits motion of the piston to a Geneva plate, the central radial slot of which engages a tapered block carried on a pin on the skirt of the upper half of the leg. Steering torque is transmitted from the block to the twin wheels through a single pair of scissor links at the rear of the leg. The geometry of the Geneva plate is such that power steering is provided through an angle of 33 deg. port and starboard. Beyond this point the block disengages from the slot in the plate and the wheels are then free to caster to a limit of 170 deg. port and starboard. Steering is governed from the captain's seat by means of a vertical tiller, which can be moved through 50 deg. each side of centre, this angle of tiller movement being equivalent to the 33 deg. per side of nosewheel steering movement.

From the tiller, chain and cable transmission (in tubular guards) passes down to a glanded countershaft which pierces the pressurized fuselage. Scissor links are fitted to the output side of the countershaft in order to accommodate retraction motion of the nosewheel assembly and, from the scissor links, a universally jointed shaft descends to the control valve mounted on top of the steering motor. Movement of the tiller is ineffective until a button in its head is depressed to energize an electro-hydraulic valve, and so introduce the steering motor into the hydraulic power circuit.

From the locked-up to the locked-down position, the nosewheel assembly sweeps an angle of about 105 deg., and the complication of the fairing-door actuation mechanism results largely from the fact that the doors are required to open and close during only the upper 15 deg. of the 105 deg. swept by the leg. Keyed to each end of the cross-head of the nosewheel leg is a toothed lever which meshes with a quadrant on the end of a projecting cross-shaft. Lugs on the cross-shaft pick up the lower ends of push-pull tubes which run forwards and upwards to pick up the arms of a pair of bell-cranks, the complementary arms of which are each pinned to the heads of dependent push-pull tubes, the feet of which are pinned to the doors.

After the first 15 deg. of downward movement from the "undercarriage up" position, the toothed lever runs out of mesh with the quadrant, and a cam frees a spring-loaded plate to drop and insert a lock peg in a hole through the quadrant, so locking the latter and, therefore, locking the doors open. Conversely, when, during retraction, the nose assembly is raised to within 15 deg. of the "up" position, the cam lifts the lock peg free from engagement with the quadrant, simultaneously with the re-meshing of quadrant and toothed lever.

It is worthy of mention that there is little spare room in the nosewheel well and, in order to ensure that the leg is fully extended so that the wheels do not foul any of the mechanism, a pair of ramps is introduced. During the final 20 deg. of retraction movement, should the leg not be fully extended, the tyres engage the ramps and so extend the leg to its limit of travel. Incidentally, it was the particular desirability of keeping the nosewheel leg as short as possible that determined the static ground angle of the Ashton being 2 deg. nose-down.

The man who, as project designer, has been responsible for the whole development of the Ashton is Mr. Harry King, and he is to be congratulated on the job he has done, for there can be no doubt whatever that, in the Ashtons, the aircraft industry will have the benefit of research equipment of great value. It may well be that the knowledge gained in these aircraft during the next five years will establish lines of practice and operation which will be reflected in the mode of high-altitude flying for a great many years to come.

C. B. B-W.

THREE NEW BOOKS

"Wingless Victory" by Anthony Richardson. Published by Odhams Press, Ltd., Long Acre, London, W.C.2. Price 9s 6d.

ON May 27th, 1940, an R.A.F. wing commander named Basil Embry was shot down while leading a Blenheim squadron over France. He was captured but escaped almost immediately, and, before he reached England nine weeks and five days later, had to fight and bluff his way out of captivity twice more.

In *Wingless Victory* Anthony Richardson brings to life this dramatic episode in the career of the present A.O.C.-in-C., Fighter Command—whose subsequent work on wartime flying operations was rewarded by rapid promotion, a knighthood and several decorations for gallantry.

The author has made a convincing, skilful reconstruction of the adventures leading to Embry's final escape. As an adventure story, the book stands on its own merits; it neither needs nor possesses professional "effect." It is also valuable as a portrait of a bold and vigorous personality.

R. B.

"Refuelling in Flight," by C. H. Latimer-Needham. Sir Isaac Pitman and Sons, London, W.C.2. Price 12s 6d.

THE fact that this book was written by Mr. Latimer-Needham is sufficient comment on its quality. As chief engineer of Flight Refuelling, Ltd., he has been responsible for much of the development work that has transformed mid-air refuelling from a stunt into a practical, efficient answer to many of the problems of present-day civil and military air operations.

The civil application of flight refuelling, to increase airliner payload or range, was demonstrated as early as 1939. Its military capabilities would have been given a thorough operational trial in 1945 had the Pacific War not ended as suddenly as it did, for a large force of Lancasters and Lincolns was being fitted with flight-refuelling equipment for long-range bombing of Japan. Instead, it was left to the U.S.A.F. to prove its effectiveness, first by the round-the-world non-stop flight made by a B-50 medium bomber in 1949, and then by the recent non-stop transatlantic flight by a Thunderjet fighter, using in each case equipment developed by the British specialists.

In this book, Mr. Latimer-Needham gives a brief history of the subject, followed by technical studies of its economics for both civil and military use, suggested designs for an ideal flight-refuelled airliner, notes on the choice of tanker aircraft and full descriptions of present-day equipment and its method of operation.

Refuelling in Flight is thus a first-class text-book for the aeronautical engineer, military strategist or airline economist.

"Richard Hillary," by Lovat Dickson. Illustrated. Macmillan and Co., Ltd., St. Martin's Lane, London, W.C.2. Price 8s 6d.

TEN years ago, when the daylight skies over Southern England were quiet again after the R.A.F.'s victory in the Battle of Britain, a young fighter pilot named Richard Hillary lay, terribly burned, in that famous hospital at East Grinstead while "surgeons laid patch after patch upon him, to make him presentable to humankind again." When they had finished, he told his story, in *The Last Enemy*, of the quick excitement of battle and the months of agony that followed. It quickly became a classic and, to date, more than 135,000 copies have been sold in England alone. Unhappily, seven months after it was published, Richard Hillary was killed.

Now, in a new biography, Lovat Dickson, who was responsible for publishing *The Last Enemy* in Britain, fills in those details of Hillary's life which are missing from his own book. He tells of the childhood that produced the man's complex character; of the nightmare months when he tried to "come back to life" again after his ordeal, when the smile of an unknown girl could make his whole life seem brighter and less hopeless; of those whose love and kindness nursed him back to mental health; and of the impact upon his life of Eric Kennington and the writings of T. E. Lawrence, which turned indecision into a firm resolve to return to flying duties.

This book will never become a classic like *The Last Enemy*, but will be welcomed by all who wish to know more about Richard Hillary.

J. W. R. T.

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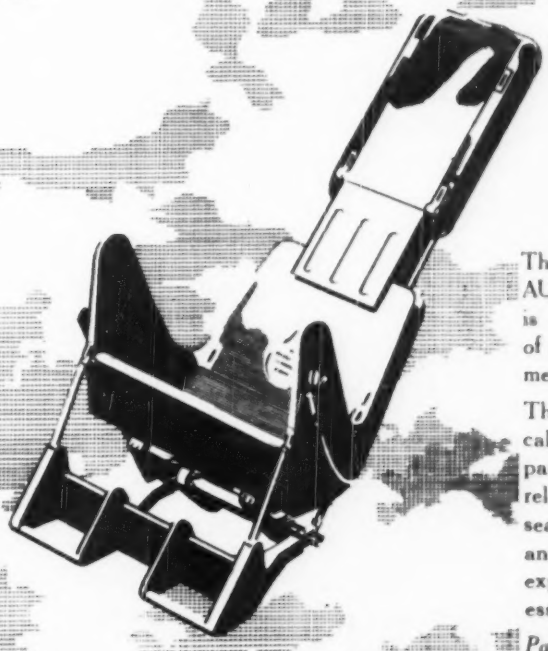

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CIVIL AVIATION NEWS

B.W.I.A. IS TEN

THAT most progressive and—at least potentially—most profitable subsidiary of B.O.A.C., British West Indian Airways, celebrated its tenth birthday on November 27th. Having first come into being at a time when surface transport between West Indian islands was disrupted by the war, the company soon proved its importance in undertaking valuable charter work for the American forces. In each succeeding year there was rapid progress and expansion of routes until to-day links are being provided to nearly all the Caribbean territories.

Eight Vikings and four Lodestars now serve 17 West Indian ports in addition to Miami. In 1949 over 49,000 passengers were carried—a figure that was exceeded by the end of the first nine months of this year.

So important is the traffic potential in this area that B.O.A.C. is known to be already contemplating the early introduction of the Comet on the route from Nassau to points in North America.

B.O.A.C. LABOUR DISPUTE

UP to last Monday there were still few signs of an early settlement of the unofficial strike involving 150 electricians employed by B.O.A.C. at London Airport. The dispute began when members of the Electrical Trades Union protested against the employment, on maintenance work, of two non-union electricians who had been transferred from B.S.A.A. Both had been suspended for some time on full pay while the subject was under discussion between the Corporation and the E.T.U., but when they returned to work an overtime ban was introduced by 130 electricians employed on the Argonaut services to which the two men were attached. Twenty-five men who refused to work overtime were suspended and the remainder downed tools on November 24th.

The Corporation's services were progressively restricted during the week until, on Friday, when the full impact of "working-to-rule" tactics adopted in sympathy by 80 electricians employed at Filton became evident, it seemed likely that all services with the exception of those to Africa would be brought to a standstill.

The initial suspension of Argonaut services is estimated to have cost the Corporation some £15,000 per day, while the total cost to the taxpayer of all cancelled services—including a loss of £7,000 a day for tickets normally paid for in dollars—was said to be accumulating at the rate of about £65,000 a day.

An appeal has been made to the electricians, through their union, to resume work while negotiations are being completed, but so far the Corporation has remained adamant in its refusal to deal directly with the strike-leaders. Meanwhile, the latest proposals made by the E.T.U. still involve the suspension of the two ex-B.S.A.A. workers, one of whom is reported to be a member of the Aeronautical Engineers' Association, which is not recognized by B.O.A.C. The situation became particularly difficult in view of the Minister of Civil Aviation's past assurances concerning ex-B.S.A.A. employees.

As in many disputes of this nature, both sides feel that a matter of high principle is involved; in this respect it bears a close resemblance to the controversy which has arisen from the attitude of the Durham County Council in requiring all its employees to be members of a trade union. Whatever the outcome may be it is doubly unfortunate that the costly repercussions of this deplorable affair should be felt at a time when the Corporation's finances are showing high promise of recovery.

As we go to press there comes the news that the electricians at Filton have decided to abandon their "go slow" tactics; this should enable the Corporation to despatch at least some trans-atlantic flights. There is still no sign, however, that the London men will follow their example.

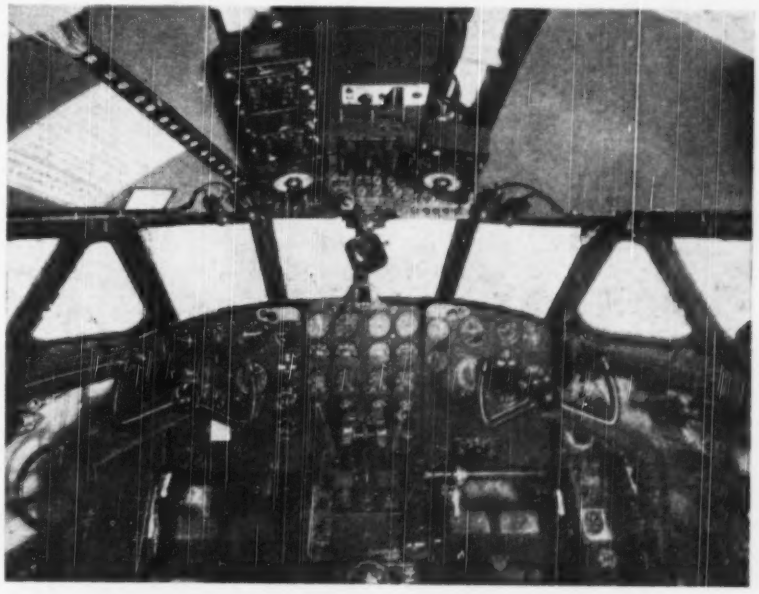
AMBASSADOR MISHAP EXPLAINED

IN a statement issued last week, the manufacturers of the Ambassador gave the reasons why G-ALFR, the production prototype, shed both its engines during a heavy landing in rough weather at Christchurch on November 13th. The statement explains that the aircraft was being tested at a forward c.g. loading and was making a power-off landing with full flap. During the final approach, which took place in a very gusty cross-wind, air speed dropped below the safe minimum for this particular case and the machine struck the ground heavily, the nosewheel touching slightly before the main undercarriage.

It was calculated that the vertical speed could not have been less than 25ft/sec—2½ times the design maximum—and that the major portion of the impact loads were taken by the main undercarriage. In such a landing, says the report, the engine-mountings, being very near to the impact point, would be expected to receive the greatest shock and in these circumstances would certainly fail at the junction of the nacelle and the engine mounting.

It is stated that the entire structure had been statically tested to 5.4g—20 per cent above the normal design factor—but any load in excess of the calculated design limit for the forward tubular mounting (i.e. 6.35g) might be expected to cause a failure-in-tension of the top longeron attachment. A simple alteration is being made to the structure so as to increase the strength still further and make the factors more consistent throughout the engine mounting.

Tyre marks on the grass runway showed that the port undercarriage took the initial impact, causing the port engine to break away first; it was immediately followed by the star-



PILOTS' PARADISE: What pilot would not envy the few whose good fortune it is to practise their craft in a workshop such as this—the cockpit of the D.H. Comet; a simpler or more accessible layout would indeed be hard to find. Immediately above the left-hand seat may be seen the two control units for Marconi A.D.F. equipment.

CIVIL AVIATION NEWS . . .

board unit as the load was redistributed. The relief provided by the failure of the mountings prevented the load from building up and thus saved the remainder of the structure. Freed of the weight of its engines, G-ALFR left the ground again and climbed momentarily before being brought down to a second landing some 450yd further along the runway. Each power plant remained whole, there was no fire and the aircraft suffered no secondary structural damage; in fact, Airspeed's hope that it will be flying again before the end of this month. Every effort is being made to ensure that the incident will cause no delay in the completion of the Ambassador's tropical trials, or in the granting of a full C. of A. B.E.A. is known to be especially anxious to have the first production version available on its promised delivery date—in time for the introduction on scheduled services during the peak traffic season next summer.

V.H.F. INTERFERENCE

IN *Information Circular No. 116/1950* the M.C.A. states that unknown broadcasting sources are causing serious interference to V.H.F. R/T. reception in aircraft flying over widespread areas of South-east England and the Midlands. On the evidence available at present the Ministry is unable to identify the cause and, so that early action may be taken, the co-operation of aircrews is being sought.

All pilots and radio operators experiencing such interference are requested to report the matter in writing to the Ministry—Directorate of Navigational Services (Telecommunications), 19-29, Woburn Place, London, W.C.1. The reports should give details of the frequency being used, time, position and altitude, other types of radio equipment which were being used when interference was heard, and the duration and nature of the interfering broadcasts.

It is to be assumed that commercial aircrews will obtain the usual formal approval from their employers before responding to the Ministry's invitation.

AMERICAN "AID" PROGRAMME

THE C.A.A. has allocated funds to provide for the installation, in 1952, of 20 out of a projected 75 terminal-type omni-directional radio ranges. They are to be installed near medium-sized airports as landing aids to replace the more costly I.L.S. equipment. A complete omni-range installation costs about $63,000.

To date the number of individual navigational aids authorized as compared with the totals originally proposed in the R.T.C.A. SC-31 Report, are given as: I.L.S., 171 out of 350; high-intensity approach lighting, 33 out of 350; D.M.E., 439 out of 816; precision approach radar, 28 out of 96; airport surveillance radar, 56 out of 172; V.H.F./A.D.F., 62 out of 228; omni-ranges, 294 now operating out of 466 originally proposed. In addition, forty-eight mechanical interlock devices for control towers have been authorized out of an original proposal for 50.

OCTOBER AIRFIELD ACTIVITY

TRANSPORT-FLIGHT landings and take-offs at United Kingdom airfields during October totalled 13,839. The total of commercial passenger movements was 182,110, while some 2,586 tons of freight were on- and off-loaded.

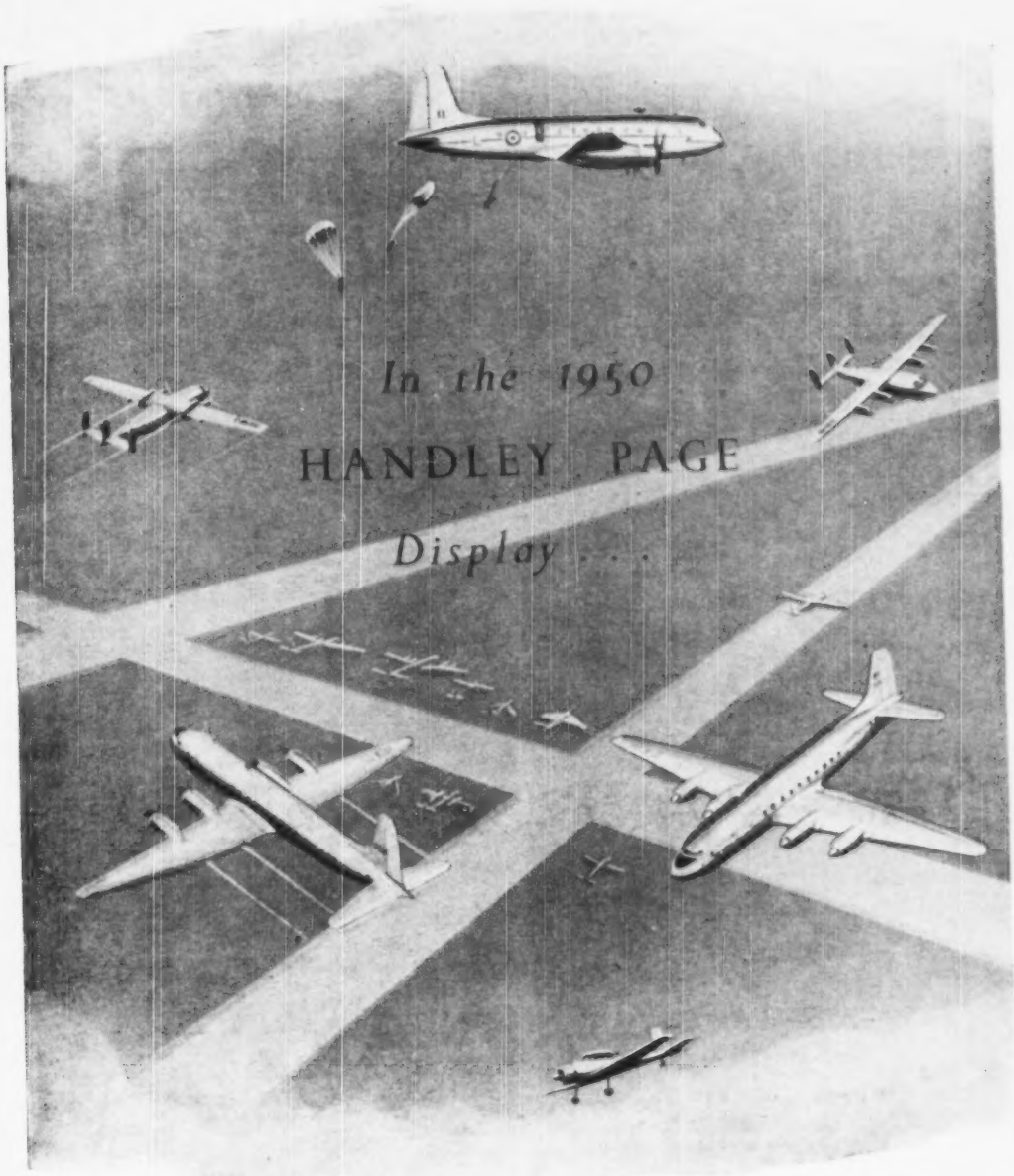
Although the number of aircraft movements was only 2 per cent higher than in October, 1949, passenger movements rose by almost 12 per cent and the figure for freight tonnage increased by nearly 32 per cent. The busiest terminals were Northolt, which handled 63,778 passengers and 596 tons of freight, and London Airport, with 51,745 passengers and 955 tons of freight. Together these two airports accounted for more than 63 per cent of the total passenger movements at all airfields and nearly 60 per cent of the total freight.

The third busiest airport was Renfrew (Glasgow), closely followed by Nutts Corner (Belfast). Over 333 tons of freight were recorded by Lympne airfield, accounted for mainly by the Silver City car-ferry service. Jersey airport (statistically outside the United Kingdom) handled 11,207 passengers during the month.

Detailed figures for all reporting airfields are given in the table below.

Airfield	Aircraft Movements			Passengers handled (terminal and transit)	Freight (tons)
	Air Transport	Other Flights	Total		
Aberdeen (Dyce)	322	585	907	1,621	17.6
Belfast (Nutts Corner)	552	29	581	9,160	40.4
Birmingham (Elmdon)	300	560	860	2,377	22.4
Blackbushe	174	590	764	2,090	95.2
Blackpool (Squires Gate)	222	1,685	1,907	777	—
Bovingdon	86	1,478	1,564	985	62.3
Bristol (Whitchurch)	55	1,285	1,340	179	.05
Cardiff (Pengam Moors)	107	2,067	2,174	317	—
Croydon	347	685	1,032	550	86.0
Edinburgh (Turnhouse)	204	1,638	1,842	1,863	1.5
Gatwick	39	307	346	339	16.4
Glasgow (Renfrew)	857	375	1,232	9,235	33.2
Hurn	8	1,626	1,634	18	4.5
Isle of Man (Ronaldsway)	509	64	573	4,695	16.7
Inverness (Dalcross)	158	62	220	694	2.9
Kirkwall	268	40	308	1,825	11.1
Leeds (Yeadon)	30	463	493	69	—
Liverpool (Speke)	418	1,003	1,421	5,200	44.1
London	2,354	1,185	3,539	51,745	954.6
Lympne	204	574	778	815	333.1
Manchester (Ringway)	738	624	1,362	6,037	147.3
Northolt	3,798	878	4,676	63,778	596.1
Nottingham (Tollerton)	34	188	222	115	—
Prestwick	545	473	1,018	8,441	34.2
Shoreham	18	786	804	73	—
Southampton (Eastleigh)	353	886	1,239	3,373	2.6
Southampton Water	24	40	64	651	11.5
Southend (Rochford)	33	1,724	1,757	382	2.7
Weston-super-Mare	3	108	111	3	—
Wick	272	36	308	614	7.3
Other Airfields	817	342	1,159	4,089	18.8
All reporting Airfields October, 1950	13,839	22,396	36,235	182,110	2,585.5
All reporting Airfields October, 1949	13,569	25,993	39,562	163,132	1,961.5
Channel Islands: Jersey	1,261	n/a	n/a	11,207	44.0
Channel Islands: Guernsey	978	n/a	n/a	6,382	46.9

TO TELL THE WORLD: A party of B.O.A.C's area and sales managers—in London for the Corporation's first world-wide sales conference—paid a visit to Hatfield, where they inspected the de Havilland works and met prominent D.H. personalities.



. . . Transports and Trainers

RADLETT LONDON READING

A new research aircraft designed to carry personnel with their equipment to very high altitudes, the Avro Ashton is powered by 4 Rolls Royce Nene Jets mounted in pairs. Like many other famous aircraft the Ashton makes good use of T.I. Aluminium Tubing, the product of another kind of research which goes on in our laboratories.

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CIVIL AVIATION NEWS . . .

BREVITIES

THE Minister of Civil Aviation has appointed Sir Walter Monckton, K.C., to conduct a public Court of Inquiry into the accident involving B.E.A.'s Viking G-AHPN at London Airport on October 31st. Sir Walter has had a distinguished career in law and in 1945 held the post of Solicitor-General.

* * *

Air France has placed a £1,400,000 order with Lockheed's for four new Constellations; this will increase to 23 the number of aircraft of this type in the company's fleet.

* * *

P.A.W.A. recently signed a new five-year agreement with the Venezuelan Government by which the company's aircraft are exempted from airport fees at the five stopping-points which they use in Venezuela.

* * *

K.L.M.'s Australian representative, who recently returned from a short visit to Holland, is quoted as saying that there is no indication of an early re-establishment of the pre-war K.L.M. service to Australia.

* * *

Work is to begin this month on the new international airport at Fuimicino, near Rome. A few miles further from the capital than is the present terminal at Ciampino, the new site is said to enjoy better weather. The first stage will be to construct the first of the six planned runways at a cost of about £2,285,000.

* * *

The C.A.A. has developed a more efficient beam-landing system which incorporates a new type of aerial, designed specifically to assist aircraft in landing on snow-covered airfields. The new aerial eliminates to a large extent the variation which snow causes in the normal glide-path indication.

* * *

B.O.A.C.'s statisticians have discovered that one of every nine "passengers" carried during the past 18 months has been an animal. This type of cargo has been so popular that the Corporation has even had to employ an expert to ensure proper handling of the 30,000 animals of many species which have passed through London Airport in this period.

* * *

It is understood that the proposal to test the C-102 Jetliner on the Australian routes of T.A.A. has been postponed indefinitely following advice from Canada that the aircraft cannot be released for this purpose for some time. T.A.A.'s operations manager, Capt. John Chapman, is now visiting this country, where he is reported to be inspecting various types of aircraft which might fulfil the company's requirements for its future fleet.

* * *

Following violations of the conditions under which flights are permitted to cross the American zone of Germany, United States authorities are said to be considering the imposition of severe restrictions on Czech civil aircraft. As Czechoslovakia would probably retaliate by refusing landing permits to West European lines, agreement is being sought between the Western Nations before action is taken.

* * *

The New Zealand Minister of Transport, Mr. William Goosman, has announced his government's intention of selling the State-owned National Airways Corporation "outright, in part or for joint State and private operation." He said that offers of purchase along these lines were being invited immediately from Britain, Australia and New Zealand; January 31st is the closing date. The eventual owner will be expected to operate the major part of New Zealand's air services, with the exception of the Cook Strait rail/air cargo service.

S.A.S. has ordered two DC-6Bs to augment its present fleet of DC-6s. They will be 58-passenger versions (i.e., with ten more seats) and will have a more luxurious cabin layout.

* * *

Iranian Airways, based at Teheran, have placed an order for a French S.O.-30P Bretagne. The aircraft was due to be delivered at the end of last month.

* * *

On B.O.A.C.'s Argonaut service between Britain and the east coast of South America, the stopping place on the Brazilian coast has been changed from Natal to Recife (Pernambuko). Recife is a larger and more important commercial centre than Natal.

* * *

The Dutch section of the International Friendship League has decided to use chartered aircraft to transport delegates between Britain and Holland for the League's four-week conference at Amersfoort next July.

* * *

Technical representatives of both A.N.A. and Bristols are examining a proposal that the Australian operator's DC-4s should be converted for Hercules power. Hercules have already been installed in a Bristol Freighter owned by A.N.A. and it is intended that a DC-4 should be similarly converted for test purposes.

* * *

During her visit to London last month, Queen Juliana of the Netherlands conferred the Gold Medal of Oranje Nassau on three members of K.L.M.'s staff at London Airport. They were Mr. V. H. King, A.F.C., station manager, Mr. G. C. Young, M.B.E., regional technical officer, and Mr. A. E. Johnson, M.B.E., assistant station manager.

* * *

It is reported from Sydney that Qantas and B.O.A.C. are now planning to stop at Perth instead of Darwin on the England-Australia route. Aircraft will therefore fly direct from Djakarta to Perth. A Qantas Constellation recently made the first non-stop flight between Japan and Australia, covering the 3,200 miles from Iawkuni to Darwin in 11 hr 35 min.

* * *

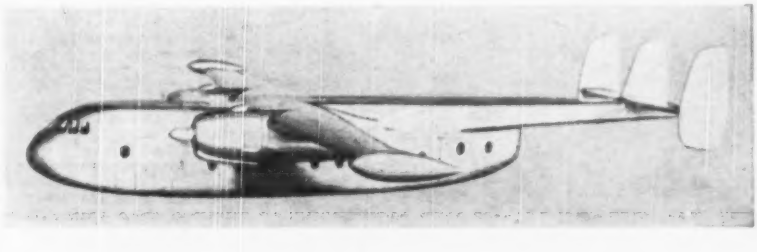
On his return to Britain from a recent 24-day tour of B.O.A.C.'s North and Central American territories, Sir Miles Thomas said that he was well satisfied with the improvements being made in the Corporation's dollar-earning North American organization. As a result of his visit two subsidiaries of B.O.A.C.—British West Indian Airways and Bahamas Airways—are being reorganized along the lines of their parent company.

* * *

Following an agreement concluded with the Maltese Government and B.O.A.C., B.E.A. is to inaugurate, on January 8th, a weekly Viking flight between Malta and Cairo. The service is being run on behalf of Malta Airways and Air Malta, Ltd., and will connect with existing schedules to and from Malta; stopping points will include Tunis and Benghazi. In addition, the Corporation will serve Catania.

* * *

Work is now in progress on the 2,000ft vehicle subway which will link London Airport's new main terminal disembarkation area with the Bath Road. The subway will pass under No. 1 runway and during part of the work traffic will have to be diverted on to the parallel runway No. 5. The subway is 80ft wide and contains two 26ft carriageways for main traffic, in addition to two "suspended" cycle-tracks; the floor will be approximately 30ft below ground-level. The main part of the contract is being undertaken by Taylor Woodrow Construction, Ltd., and will be completed by the end of 1952.



FREIGHTER PROJECT: This model of the Airspeed AS-57 long-range freighter reveals that, in spite of its bulky fuselage, the aircraft is exceptionally clean in form. Powered by two Centaurus 661s, it is designed to cruise at 237 m.p.h.; at its overload weight of 60,000 lb, 200-gal wing-tip tanks will give it a range of 3,080 miles with 9,600 lb payload.

"LESSER FLEA" TURBINE-STARTING

Some Observations on the AiResearch Pneumatic System

By STANLEY H. EVANS, F.R.Ae.S., A.F.I.Ae.S.

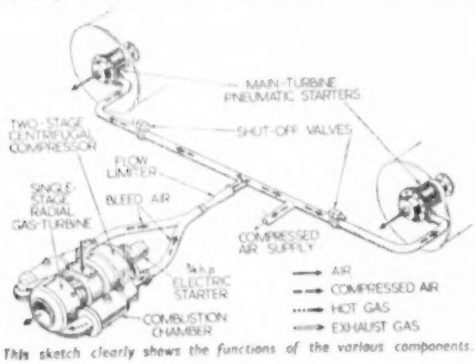
Too often the "feminine interest" inseparable from American manufacturers' photographs adds nothing of technical value to the illustration: but here the presence of attractive "Lab technician Florence Williams" does provide a useful idea of the size of the AiResearch auxiliary power unit and—in her hands—pneumatic starter.

MAINLY because of the high starting torque required to overcome the drag inertia of the rotating system, plus the fact that the compressor of a gas turbine must be accelerated up to a fairly high speed in order to generate enough compression to support combustion, the starting of gas turbines poses a more difficult problem than that met with in the piston engine. Hitherto, all jet aircraft for the U.S. Navy have been equipped with electric starters, but a heavy weight-penalty is exacted or the battery capacity is inadequate. On the other hand, the use of external battery carts or self-propelled vehicles for starting, while feasible enough at shore stations, must be considered an encumbrance within the crowded confines of a carrier flight deck. And so the Bureau of Aeronautics has been encouraging the development of self-contained starting systems installed in the aircraft and capable of providing any number of starts without the assistance of an external ground supply.

To date, the AiResearch pneumatic system, as installed to start the Allison T-40 dual turboprop of the Skyshark (described in *Flight* of November 16th and 23rd), is probably the most advanced for this purpose. Based on the chain-reaction principle of the lesser flea biting a bigger one to get the donkey moving—or, mechanically speaking, a cumulative power build-up—the system embraces a self-contained auxiliary power unit (a.p.u.), consisting, essentially, of a miniature gas-turbine compressor unit connected on the compressor side via piping to a pair of high-speed air-turbine starter units which are, themselves, attached directly to the aircraft propulsion units.

The auxiliary gas turbine is the basic power-source of the system, while the air turbines function as pneumatic starters in lieu of the conventional electrical type. There is, however, a small ¼ h.p. electric motor, powered by a 24-volt 100-amp storage battery, to provide the initial bite for spinning up the compressor of the auxiliary gas turbine. The fuel supply for the latter is taken from the aircraft fuel tank.

The working of the system can be more readily understood by running through the sequence of events after the pilot presses the starter button. This energizes the electric starter motor, which spins up the compressor of the a.p.u. to about 6,000 r.p.m., enough to start combustion; the a.p.u. is then accelerated up to 40,000 r.p.m., at which speed it develops about 65 h.p. at sea-level. At this point, the shut-off valves to the air-driven turbine starters are opened and compressed air is bled from the compressor to energize them. (Be it noted that the compressor of the a.p.u. is an oversized two-stage radial unit, of sufficient capacity to supply both its own gas turbine and excess bleed air for the air turbines.) These air turbines, or pneumatic starters, develop 35 h.p. at 64,000 r.p.m. and turn over the main aircraft turbines at about one-third their rated speed, at which point the main-engine start is made. The present pneumatic starters weigh about 20 lb apiece, complete with reduction gearing and clutch, while the a.p.u. weighs approximately 150 lb completely packaged and insulated.



This sketch clearly shows the functions of the various components.

From a weight-economy standpoint the AiResearch system becomes more advantageous in the case of large multi-engined aircraft, since the basic auxiliary power unit may be used to supply any number of engines by the addition of pneumatic starters to each engine. Again, it opens up the possibility of an all-pneumatic system for driving all those accessory services such as landing-gear retraction, wing-flaps, air brakes, control servos, bomb-bay doors, etc., now generally performed by hydraulics. Another obvious service that can be supplied by the pneumatic side of the a.p.u. is cockpit and cabin air-conditioning, while the jet side of the auxiliary gas turbine can be utilized for de-icing and other heating services.

Whether the game is worth all these airborne candles is, perhaps, open to question—at least in the case of single-seater fighters and bombers with accessory systems still largely operated by hydraulics. Moreover, bearing in mind the obvious fact that a carrier is a floating power-station well fitted to supply all the necessary electrical juice, it would seem more logical to transfer most of this added complexity and weight on to the broad back of the naval architect instead of penalizing the aircraft designer's product. If it be granted that battery-carts *are* a hazard on a crowded flight deck, the carrier of the future might well be provided with a system of spring-loaded, retractable plug-in connections at suitable distribution points along the deck. The solution is analogous to watering the garden by means of an underground sprinkler system instead of hauling a water-cart and hose around the landscape.

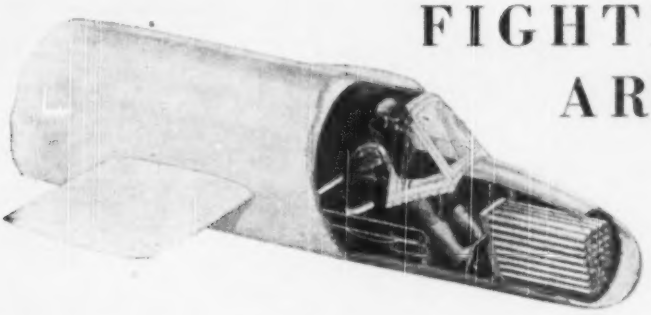
[*On page 521 are illustrations of a British turbine-starter utilizing the power of a cordite cartridge.—Ed.*]

SILICONE DEVELOPMENTS

THE firm of Albright and Wilson, Ltd., and the Dow Corning Corporation of America announce the formation of a new company, Midland Silicones, Ltd., which assumed on September 25th all the activities previously undertaken by the silicone department of the first-named firm. For the time being the new company will continue to market silicone products imported from America, but when Albright and Wilson begin manufacture in England it will act as their agents.

Silicones are of particular interest to the aircraft industry because of their stability at extremes of temperature. Silicone rubber, it is stated, retains its flexibility over the temperature range −110 deg F to 500 deg F, and is used for heat and oil-resistant packings and seals, flexible couplings in heater ducts, and for insulating flexible cables used in high temperatures.

FIGHTER ARMAMENT



The Natter rocket-propelled interceptor carried a battery of 30 R4/M rocket tubes in its nose, covered by a jettisonable cap: they were intended to be fired as a salvo into the target formation.

Part V: Lessons from the Luftwaffe . . . . . By A. R. WEYL, A.F.R.Ae.S

In the first part of this article (August 24th) Mr. Weyl reviewed the history of aircraft armament and showed how lessons of the past had, in his opinion, been neglected by those responsible for developing British equipment in the Second World War; in the second instalment (September 21st) he discussed German equipment; in Part III (October 5th) he analysed the respective claims of guns versus rockets; and on November 23rd he discussed the effectiveness of various types of shells and fuses, and explained principles of elementary ballistics in their relation to air armament. In the present instalment he analyses Luftwaffe combat experiences, particularly with the use of the R.4/M air-to-air Rocket missile.

RATIONAL design of a fighter aircraft centres on the potential target. It is the latter which should form the focus of attention for those formulating operational requirements; on the shape, properties and habits of the flying targets to be defeated almost the whole of the technical specification should be based. Hence the very obvious need for technical and scientific intelligence-gathering and analysis.

The sooner the target can be destroyed, the better for the intercepting defender: there is less danger from defensive armament, less chance of the enemy taking evasive action; less waste of ammunition; a better chance of surprise; more scope for dealing with other targets; and better "turn-over" of men and equipment.

As carriers of weapons present-day high-speed jet fighters are handicapped at high speed and high altitude, for the aircraft ceases to provide a steady gun- or launching-platform. At present and future speeds the time of "meeting" the enemy in a position favourable for opening fire is exceptionally short, and there is rarely an opportunity to repeat an attack which has failed in its purpose. Flying at great altitudes, the enemy aircraft is difficult to spot (and to recognize) at long distances, unless it forms vapour trails. Finally, the radii in which interceptors are able to turn have vastly increased, so the manœuvrability necessary for taking aim has become much reduced. It is, therefore, obvious that, as a carrier of weapons requiring accurate aim, the modern intercepter is grossly inferior to the original fighter with which the history of air combat began. This is, indeed, the main argument which is put forward in favour of the guided air-to-air missile with homing devices. Its fallacy is, however, the fact that such devices, of necessity rather large and complicated, will remain more or less one-shot weapons of a rather unreliable character, comparable with yet always inferior to the marine torpedo—which, so far, has conspicuously failed to supersede the naval gun.

Logical Train of Deduction.—From assumptions as to where, when and how the flying target shall be met, and from the target's dimensions, vulnerability, mobility and defensive power, the immediate means of destruction which is needed, i.e., the type of projectile, can be deduced. In turn, the determination of this factor, and consequently of whether one or many hits are necessary, leads the designer to find the appropriate kind of weapon and its calibre. Once the weapon (or weapon combination, or weapon battery) is selected, an assessment of its positioning in respect to the target, its aiming, and the probability of its producing hits under combat conditions will result in a specification for the intercepter in its absolute quality as a carrier of the specified weapon. The aircraft specification thus deduced must include provision for ammunition storage and the fuel to be carried. Only by such a logical and methodical manner of approach can the aircraft designer visualize the most efficient intercepter. The time has long passed when an intercepter was merely a good aircraft, with effective speed and climb, into which some bright "lads from the Ministry" put any guns which happened to be lying about.

Adopting the "splinter" hypothesis (see Part IV), the lethal cone or sphere is calculated from the minimum density of shell splinters which have sufficient kinetic energy and size to cause decisive damage. War is not primarily a business with the purpose of killing people, and nor is air combat: the aim is to enforce one's own will upon the enemy—in air combat, to down the enemy aircraft, and usually to do so in the shortest possible time. It is open to tactical assessment to decide if this objective is to be achieved by "shot" or by "shrapnel," i.e., by applying several hits with one burst, or by a single hit with a larger projectile. The latter is, of course, the more modern way, and preferable. The decision yields, in turn, the technical limits for minimum shell-weight splinter-formation, and the H.E. charge required to produce the splinters.

Since the calibre length of a shell is a quantity within practical limits, determined by inner and outer ballistic experience, the smallest applicable calibre is easily ascertained. The target's mobility (in relation to the attacker) and the sighting aids which are available permit assessment of the widest range over which fire must be effectual. This, again, is a tactical deduction based upon appropriate intelligence and experience. The range and the target's defensive abilities determine, technically, the desirable trajectory, i.e., they define the lowest admissible muzzle-velocity. From the probability of achieving hits on the basis of average burst-dispersion the requisite number of rounds to be fired can be calculated. Of these data, the calibre, the shell weight, the muzzle-velocity, and the rate of fire are fundamental for the design of a gun which will meet the operational requirements.

Similarly, if reliance is placed primarily on blast effect, the minimum quantity of a given kind of high explosive that will guarantee destruction has to be found. This quantity of H.E. may be applied either in a single projectile or by a number of simultaneous or quickly successive hits (bursts lasting up to, say, two seconds). From the percentage of probable hits, the H.E. volume required per shell determines the calibre, assuming a practical section-density.* Next it must be decided how such a "mine" shell may best be conveyed to the target: this may be accomplished either over a long range at high trajectorial velocity, or over a short range at lower velocity but with greater density within a burst.

The argument of splinter v. blast in predominant effect upon the target is closely related to the problem of optimum calibre. For action by blast, greater calibre is not only necessary but practicable in aircraft-gun design. This fact justifies the policy of calibre increase which characterized Luftwaffe development. Russian fighters, too, occasionally carried guns of 32 mm calibre as early as the spring of 1942, and used them in air combat.

Superiority in flying speed was formerly the principal characteristic of the intercepter. Nowadays the case is altered, for there is little difference in speed between a jet bomber and a jet fighter. This will remain true so long as the interceptor has to avoid transgression into the transonic speed regime (which, most probably, will exclude aimed fire for all practical pur-

**Section-density—Projectile mass divided by its maximum cross-sectional area (see Part IV).*

FIGHTER ARMAMENT . . .

poses). Consequently, the modern interceptor will have to open fire at long range, with high fire-density and with the certainty of a kill, even if only one of the shells scores a hit; no "repeat performance" will be practicable. So far as ordinary shell-guns are concerned, such demands upon armament are contradictory. Calibre increase is opposed to greater rate of fire, and the latter property cannot be condoned with a high muzzle-velocity. Technically, this necessitates turning to other weapons. Similar arguments hold good in respect of interception at supersonic flying speeds. At such speeds, the quick manœuvring of the gun into attack position presents technical and physiological difficulties. Attacks at close range can, therefore, be deemed highly improbable. The target will allow only glimpses for taking aim and firing and, because of reduced manœuvrability, a repeated attack is unlikely.

Experiments in Destruction.—During the late war, the Germans found cause to develop adequate interceptor armament of the kind indicated. Proceeding methodically, they began by establishing experimentally how the destruction of a bomber could best be effected. The ideal was, of course, to achieve this purpose by a single hit, out of a number of shells fired—or, better, by a close miss. The need to approach this ideal had become obvious from actual fighting experience in air combat: photographic evidence collected during attacks by Fw190 fighters against B-17 bombers had proved that only two per cent of the shells fired produced hits, against a minimum of five per cent which could be reasonably expected from calculations based on maximum dispersion. Moreover, the Germans early realized that with jet and rocket interceptors under development, the curves of pursuit would allow the pilot to hold his target in the sights for an extremely short time only. They also had to reckon with the "snaking" characteristic of high-speed aircraft, referred to in Part IV of this article. In addition, the experts were painfully aware that the speed superiority of the interceptor was vanishing quickly.

The close "box" formations in which Allied day-bomber forces had finally learned to operate, and their substantial defensive fire-power in all directions, obliged the Germans to attack from ranges as great as 800 or even 1,000 yards. This, too, demanded appropriate armament. Even the 30-mm Mk. 108 shell-gun with a muzzle velocity of 1,650 ft/sec had too curved a trajectory to guarantee a sufficient number of probable hits. Obviously, a larger calibre with high muzzle-velocity was needed.

Experiments by Burgsmueller at the Rechlin establishment, conducted on captured four-engined bombers (of smaller size than the present-day "medium" types) proved that, to bring down such an aircraft, direct hits by H.E. shells were required in the numbers shown in the table at the foot of col. 2.

The minimum amount of H.E. shell-filling ("Hexogen-Al") necessary to produce destruction was established at between 15 and 18 oz (420 and 500 grammes).

As a matter of comparison it is interesting that, according to R.A.F. assessment in 1939, no fewer than 850 hits by bullets fired from light machine guns (Lewis) were considered necessary to bring down an aircraft in A.A. practice—"lucky" hits, of course, excluded.

Operational evidence collected by the Germans confirmed that in order to produce twenty direct hits by 20 mm shells in air combat, no fewer than 1,000 rounds would have to be fired, all most carefully aimed. Using the otherwise excellent Mauser MG.151/20 non-synchronized equipment (four guns firing at 700 rounds/min each, with a muzzle velocity lower by only 5.5 per cent than that of the British Hispano Mk. 5 gun), this meant 21.5 seconds' continuous firing during a single attack—well-nigh an impossibility.

The Sum of Experience.—This suggests that, basically, the present British interceptor armament of four 20 mm shell-guns is, *a priori*, insufficient, even against obsolete bombers of 1941 design; it also tallies with the operational experience collected by the Luftwaffe during 1943 and 1944. According to air-combat statistics covering the period between January and October, 1944, the Luftwaffe lost one of its 20 mm-gun fighters for each Allied aircraft (of any type) shot down.

The argument that Allied bombers were indeed shot down by 20 mm-gun fighters, contrary to the conclusions drawn from the experiments and statistics, does not hold good, simply for the reason that the experiments related to *probabilities*, and not to lucky lethal hits. Likewise, aircraft have been "bagged" by riflemen with a single pot-shot. Not so long ago, a light aircraft making an airfield circuit was even brought down by a high-kicked football! Yet it would be futile to reason that rifles or footballs should be considered as A.A. weapons. Moreover, the German conclusions intentionally neglected all destruction arising from secondary causes, e.g., by the incendiary effect of the H.E., by subsequently initiated explosions, and so forth.

Another conclusion derived from the German experiments was that no type of ammunition was required for successful air combat other than "mine" shells. Even before the outbreak of the war, the German experts had been partial to such H.E. shells; now their superiority was established once more, with pointers clearly indicating the path of future progress. H.E. produces sufficient incendiary effect in contact with fuels, coolants, etc., while against such armour as is practicable with aircraft, the large-calibre "mine" shell proves sufficient. As for tracer ammunition, the period of its usefulness has passed.

The experiments rendered absolute evidence that the minimum practical calibre to destroy piston-engined bombers is 30 mm; and taking into account further technical and tactical development (expected for late 1945 had the war continued), the need for 50 to 55 mm calibre guns was foreseen, and designs of equivalent calibre (2in to 2.17in bore) subjected to intense development. Such calibres, however, even when combining medium muzzle-velocities with a reasonable rate of fire, result in rather cumbersome and heavy weapons. An urgent need was thus felt to arrive at more appropriate types.

The experience collected with airborne recoilless guns had not been encouraging enough to suggest this variety as a quick solution. The self-propelled shell, fired from low-velocity mortars, was still in the first stages of development, although not unpromising in larger calibres. But with rocket missiles, a makeshift attempt (which maimed an American attack on Schweinfurth) gave surprisingly good results.

Consequently, the development of a small supersonic rocket missile, equivalent to a 55 mm shell and of the same calibre, was taken in hand directly by an energetic and capable armament group of the German Air Ministry. The resulting R.4/M rocket (of 7.75 lb launching weight) had an immediate and amazing success in the few weeks during which it was operationally tried. An automatic launcher was developed to discharge missiles at a rate of 500 to 600 rounds/min; it weighed only 55 lb and the automatic feed was very ingeniously arranged. It saw, however, no further operational service.

Comparative data for this novel armament and guns have already been given (Part III of this article, October 5th). The aircraft designer, of course, has no wish to change from four 20 mm guns to a single 55 mm weapon—unless the Christmas-tree tradition be revived; but he may well be able to change over to rocket-missile armament.

In respect of flatness of trajectory, the 20 mm Hispano gun scores. The R.4/M rocket is, however, only the beginning of a new development, so the comparison is not quite fair. In the opinion of former Luftwaffe experts who had operational experience in air combat, a high rate of fire should rank superior to flatness of trajectory, provided that gyro sighting devices are used. There, too, is overwhelming proof that a greater calibre is preferable to high muzzle-velocity.

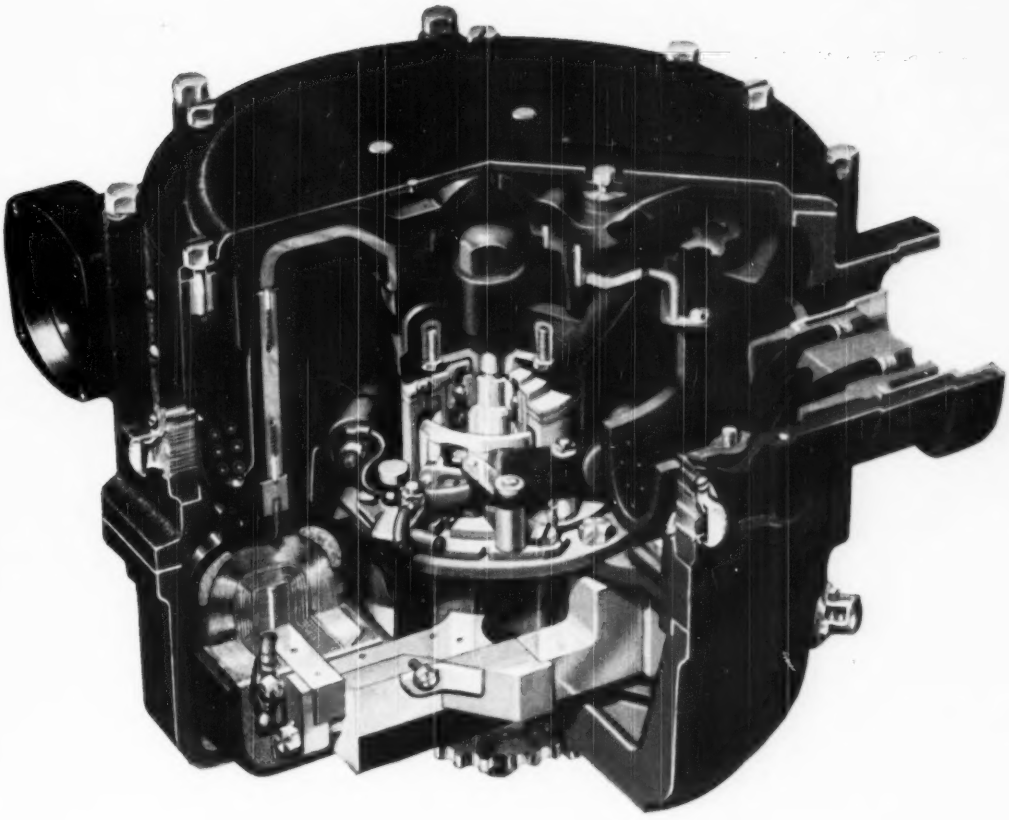
Luftwaffe Rocket-missile Experience.—On the strength of the experimental evidence and of the tactical conclusions derived therefrom, Col. G. M. Gollob, then in charge of Luftwaffe fighter requirements and operationally highly experienced, urged a speeding-up of R.4/M development and basic modification of interceptor armament.

For operational trials, Me262 twin-jet fighters (modifications of the original day-bomber version first used in the summer of 1944) were equipped with four 30 mm guns—of the Mk. 108 type, then already considered obsolescent—and also with 48 of the first series of R.4/M rockets, primitively mounted in exterior racks underneath the wing. In February, 1945, some 60 interceptors of this kind became available, all substantially slower than 500 m.p.h. at optimum altitude and afflicted with engines of short life. Judged as a weapon-carrier, the aircraft was undoubtedly the best then in production, yet its operational characteristics were reputed to be far from ideal: it could operate for about 50 minutes only, required a full-load take-off run of nearly 2,000 yards, lost its controllability when dived to more than 590 m.p.h., and was exceptionally throttle-sensitive: at falling revolutions approaching 6,000 r.p.m., the turbojets were likely to stop, and could not be restarted in flight. In all, the Me262 fighter was far from easy to fly, quite apart from its somewhat haphazard conversion to a fighter.

Yet on April 7th, 1945, a group of these interceptors brought

SHELL EFFECTIVENESS, THEORETICAL AND PRACTICAL

Calibre of Shell	Minimum Number of Hits Required (H.E. Mine-type Shell)—Test Results.	Hits Actually Required—Combat Statistics against B-17s
Rifle calibre or 12.7 mm (0.5in)	Not investigated	50—60
20 mm	20	20
30 mm	4	7
55 mm	1	Not established



DUAL IGNITION IN A SINGLE UNIT

Designed for the 12-cylinder Rolls-Royce "Griffon" aero engine, this magneto is the centre of an ignition system in which one magneto is used for the twenty-four sparking plugs. The basic principles of design can be applied to other aircraft engines. Rotax have full servicing and technical liaison facilities in Canada and Australia, which ensure complete and immediate overhaul service for their electrical equipment.

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ROTAX

Tactical ground attack—

GLOSTER METEOR

GLOSTER AIRCRAFT CO. LTD. (MEMBER OF THE HAWKER SIDDELEY GROUP)

P.V.

FIGHTER ARMAMENT . . .

down no fewer than 25 B-17 bombers during a single attack. High-ranking U.S.A.F. officers stated then that it would have taken the Allies three years to develop a comparative fighter. The advice given to Allied bomber pilots was to let the Me262 approach to as close as 1,000 yards, and then to turn sharply, so that the interceptor would be in front of the bomber, and thus harmless. The inference is obvious.

Originally, the 30mm Mauser MG.213 shell-gun was to have been installed—a far superior weapon of unequalled performance among automatic guns—and the rocket missiles were to have been fired with the automatic launcher mentioned before; in addition, the fully automatic type EZ./42 sight was to have been employed. As it was, insufficient equipment of this kind was available for the operational trials.

In spite of these serious shortcomings, the new equipment met with amazing success. Combat statistics covering the period February-March, 1945, proved that for every Luftwaffe fighter lost no fewer than seven-and-a-half Allied bombers had been destroyed—i.e., an increase of more than 650 per cent in effect.

Never before had any change in armament produced such a convincing improvement expressed as a victory-to-loss account. During the same period, incidentally, the account remained steadily at 1:1 for Luftwaffe Fw 190 interceptors equipped with 20mm guns.

What these comparisons really imply is best understood by referring to Mr. Churchill's appreciation of the early successes of R.A.F. fighters in France during the Dunkirk evacuation (May, 1940). During this period the British victory-to-loss account reached three or even four victories to one loss, operating against obsolescent Ju87 dive bombers and bombers having no fire-arm defence. Mr. Churchill considered this air-combat balance highly gratifying and most encouraging. During the Battle of Britain the (corrected) victory-to-loss account was actually 1.9 to one loss. On the glorious September 15th, 1940, the account was 1.4:1, i.e., 56 Luftwaffe bombers shot down against the loss (complete write-off or missing) of 40 British fighters. The import of the 1945 improvement of the Luftwaffe interceptor equipment may, hence, be appreciated.

The main reason for the Germans' undeniable operational success in 1945 was, clearly, the employment of the R.4/M rocket which, still far from being fully developed and possessing a high dispersion, proved to be operationally superior to rapid-firing shell-guns.

Consequently, all the later projects of the Luftwaffe were to rely on the use of this weapon. The "Volksjäger" He162 was to have 60 R.4/M rockets in addition to two or three 30mm guns; and the same armament was to be provided for the Me263 Komet tailless interceptor with rocket propulsion. Also, the half-expendable Natter rocket-propelled interceptor was to have thirty R.4/M missiles (to be fired in a salvo) as its sole armament.

A jet fighter with two 55mm Mk.112 shell-guns was ready for comparative operational trials, but found no further use. The armament employed was the latest automatic shell-gun, specially developed to serve as a standard weapon for air use as well as for ground duty as light A.A.

Characteristically enough, Me262 twin-jet fighters armed solely with 30mm shell-guns gave a far less satisfactory account of themselves in air combat, although up to six guns were experimentally installed and used in operations.

To-day, it appears that Me262 fighters are being built in Russia, under a different designation, and having more powerful and more reliable turbojets utilizing British experience. Armament with 30mm shell-guns follows the Luftwaffe example, and the guns themselves are of German design. In other Soviet fighters, too, the use of German 30mm guns has been reported. The weapons were actually in mass production at Poznan when the Russians entered. As regards rocket missiles, the Russians have never lagged far behind the Germans, and a substantial number of German experts are now working for them.

(to be continued)

TRANSATLANTIC ANNIVERSARY

An International Occasion : Prestwick's Annual Celebration

EACH year the anniversary of the commencement of transatlantic air services into Prestwick is celebrated by a dinner at the Airport Hotel, and the occasion has already become one of the outstanding annual social events of this kind. A new high standard was established in this tenth anniversary year when, on November 29th, Scottish Aviation, Ltd., were the hosts to a large international gathering, and the speeches all bore witness to the enthusiasm felt for commercial aviation. A large number of those present were pilots of this or the previous generation, and, as would be expected on such an occasion, many had operated across the Atlantic, especially during war-time.

His Grace the Duke of Hamilton and Brandon, G.C.V.O., P.C., A.F.C., in the chair, proposed "The Occasion." He asked the guests to drink to the health and prosperity of North Atlantic passengers and air services.

"International Aviation" was the toast of Brig. Gen. J. W. Wood, newly appointed United States air attaché (General Ackerman officially handed over office three weeks ago, and has now returned, with his family, to America). General Wood said no place on earth had played host to so many weary American airmen who had flown across the uncompromising Atlantic as had Prestwick. He referred briefly to highlights in the development of international aviation, mentioning in particular the Air Navigation Convention held in Paris as long ago as 1910. He named pioneers in several countries, and remarked that the modern aircraft was the greatest collection of "international nuts and bolts." In conclusion he stressed the significance to commercial aviation of the aim stated as early as 1919, i.e., "to provide for the free and innocent passage of commercial transport over the territories of all."

The reply came from Mr. V. H. L. Dubourcq, North Atlantic divisional manager for K.L.M., deputizing for Dr. Plesman. He said that international aviation was still being hampered by the human mind. He thought, also, that there was too much "nationality and trademark" about airlines for the ideal of international transport.

"The British Aviation Industry" was proposed by Sir Wilfred Ayre, who felt that much value had come from the interchange of technical and practical commercial knowledge between shipping and aviation. His industry and aviation worked together for a common cause—transportation of goods and people with proper economy and with regard to the degree of urgency. Sir Wilfred said he had travelled more than 100,000 miles by air, and wished to pay a tribute to the standard of technical skill embodied in modern aircraft. He thought that in no industry was the quality of service rated higher than in aviation. It had been studied from a completely new angle, and the conclusions applied. He ended with an appeal that young men should be stimulated and encouraged to undertake industrial leadership: if this were done our successors would have no cause to be ungrateful.

Replies to this toast came from a manufacturer and an operator, respectively Mr. W. T. Gill, C.A. (Rolls-Royce, Ltd.), this year's president of the S.B.A.C., and Mr. Peter Masefield, M.A., F.R.Ae.S., chief executive of B.E.A. Mr. Gill spoke of his special interest in Scotland, and went on to say that the aircraft industry would not flatter itself that it was as yet a serious business competitor to shipping, but he looked forward to the day when it would be.

Referring to the recently announced expansion of the production of the Rolls-Royce Avon turbojet, he said that his company was coming to Hillington again because of the very satisfactory way such work had been tackled there in wartime. He thought that the British industry was in sight of providing equipment for airlines as good as, or better than, that from any other country.

In a lively and humorous speech which pleased everyone, Mr. Peter Masefield managed to make a reference to a variety of both topical and local matters and to the people concerned. He referred to Scottish Aviation's work in preparing B.E.A.'s Pionairs, saying that these would be the best version of the DC-3 in Europe. (The first is now completed and about to be delivered.)

The final speaker, Mr. J. Murray Watson, M.A., proposed "Our Hosts," tracing the early association of the Duke of Hamilton and G/C. D. F. McIntyre (respectively chairman and managing director of Scottish Aviation, Ltd.) in 602 (City of Glasgow) Squadron R.Aux.A.F., and that of the Earl of Selkirk with 603 Squadron. He mentioned also early associations on the Houston Everest expedition of 1933. He appealed to Mr. Peter Masefield for more Scottish feeder services. It had taken him almost half as long to get from Prestwick to Edinburgh by land transport as it had to cross the Atlantic—including a convenient diversion, due to weather, from London Airport to Prestwick.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Air Safety

I AM prompted to write an answer to Mr. Hornsey's letter in your issue of November 23rd. He says "The low survival-rate in crashes is largely due, we know, to lack of backward-facing seats. . . ." I agree, and there is ample evidence in support. But although Mr. Hornsey says "we know" this, I find it hard to believe the "we" includes those responsible for the form of our aircraft safety provisions. Otherwise this simple, relatively inexpensive, often-suggested modification would be a requirement in all cases except where the aircrew are obliged to look where they are going!

As for briefing passengers in ditching and crash drill, while agreeing in principle I think it is unfair to compare such briefing with boat drill aboard ship. In the passenger ship, boat drill is a jolly affair conducted on a sunny day (if possible), where passengers are shepherded by polite crews and form into boat parties, thus promoting better social contact with fellow passengers. No one really believes that a wreck is likely to recall him to the boat deck in conditions of grim reality. But this optimism is not present amongst all air passengers, some of whom are apprehensive throughout their flights. Ditching drill is definitely a tricky matter and should not be plunged into with civil passengers as can be done with Service aircrew. This state of the air passenger's mind may be unjustified, but is promoted by the "good news-value" of air accidents which occur periodically.

ROBERT BICKNELL.

Godalming, Surrey.

Those Saucers Again

SO fantastic are the many theories as to the source of flying saucers that I am prompted to reason out a likely explanation myself.

They are mostly reported from certain parts of America and, in the rare instances when seen over land, are said to have dissolved within a few minutes. An attempted close-up of one during flight caused an aircraft to crash.

Certain areas in America are noted for violent cyclones, and "flying saucers" are possibly formed when water or water vapour is caught up in the vortex of a cyclone and sucked up to a height at which it freezes. Also, it might be caused to spin and be finally precipitated into independent flight. Its transitional and rotational speed could normally maintain it in flight through various manœuvres until it evaporates or disintegrates, and woe betide anything in the proximity!

F. WHITTAKER.

Bitterne, Southampton.

Historical Aircraft

THE revival of historical types of aircraft seems to be of more than passing interest to a widening circle of enthusiasts in these days, and I would be grateful for the opportunity of replying to the letters from Mr. R. W. Kenworthy and Mr. A. H. Curtis in your issue of November 9th.

With regard to the Shuttleworth Blackburn monoplane, I am most anxious that this machine should be correctly dated, and in the light of Mr. Kenworthy's remarks (your readers will recall his distinguished record as test pilot for the Blackburn Co.) I have re-checked on the evidence.

First, there is no doubt that this machine is the one built for Cyril Foggin, flown by him and Harold Blackburn, and later passed on to M. F. Glew, from whom we acquired it. Foggin was a qualified Bleriot pilot at the time that Christie, Glew, Buss, Spink and others were learning to fly at the Blackburn School towards the end of 1912, and Harold Blackburn and Foggin gave exhibition flights with this monoplane in the early part of 1913. There is a picture of them with it in your issue of April 5th, 1913.

Flight records that Foggin bought the machine in the first two weeks of 1913, and thus it is reasonable to assume that it was designed and built, even if it was not flown, in 1912. I think, therefore, that it can fairly be described as a 1912 type, but I would be very pleased to hear of any further evidence that may be available. Perhaps Mr. Kenworthy would write to me about this.

Mr. Curtis is quite right about the Bleriot. This machine is, of course, the same one that the late Richard Shuttleworth flew before the war, and has a rudder with a single horn balance. The larger, double-horn-balanced rudder was fitted to a few Anzani type XIs and, I think, to all the 50 Gnome versions. In an endeavour to improve the somewhat sketchy directional control a rudder of the latter type was fitted (without much improvement); I am afraid the fact that the original has not yet been refitted escaped me when describing the machine in my letter of September 28th.

L. A. JACKSON.

Old Warden, Beds.

Outmoded Fighters?

READERS of the *Daily Telegraph* dated November 15th will have seen headlines—"Speed of Soviet Jet Planes," "Faster Than U.S. and British Types," "R.A.F. may be equipped with American Fighters." To those who take a keen interest in aviation the first two come as no surprise. Meteors and Vampires, good though they were, are now no good for front-line interception where swept-wing aircraft are concerned, and are outdated by the later Russian types—Yak, Mig and La, numbers of which are in squadron service. The Venom, a type not yet in service, has a top speed approximately the same as that of the P.1040, which has been out for a long time and for which orders should have been placed long ago, so providing us with a 620 m.p.h. plus fighter which could have been in service for at least a year. The 1040s should then have been kept on while some squadrons would receive P.1052s and/or 510s, then again with P.1081s or 535s, so providing a balanced air force.

Hawkers and Supermarine, whose superb aircraft brought us through the Battle of Britain, have thus produced jet types of very advanced designs for which, as far as is known, no orders have been given, except by Australia for the P.1081. When Sweden has her first Saab J-29s it leaves Great Britain behind three Powers in production of swept-wing types.

Public attention should be drawn to the fact that Fighter Command is not equipped with the latest possible jet fighters. In the recent air exercise it would have been interesting to see if Meteors and Vampires could intercept a bomber like the B-45, while, if B-47s had been used, it is doubtful if any British fighters could catch, let alone intercept, it. We should be careful not to fall in the pre-war rut of one or two fighter types in service for years; if a second Battle of Britain should ever come, I fear that we should lose unless we had a large amount of American help. The long-term policy now being pursued can let us down badly in sudden emergency.

ONLOOKER.

Chatham, Kent.

[Should the R.A.F. be obliged to use very fast American fighters it would not be altogether surprising if, as a *quid pro quo*, the U.S.A.F. adopted a type such as the D.H. Venom, which possesses high-altitude-fighting qualities much superior to those of any American machine.—ED.]

FORTHCOMING EVENTS

Dec.	7.	Ariel Club (Air Ministry and M.C.A. Social and Athletic Association) : Annual Ball.
Dec.	7.	R.Ae.S. : "Relative Merits of Centrifugal and Axial Compressors"—Discussion between Dr. E. S. Moult, B.Sc., M.I.Mech.E., F.R.Ae.S., and H. Pearson, B.A., A.F.R.Ae.S.
Dec.	8.	R.Ae.S. (Preston) : Annual Dance.
Dec.	9	Surrey Gliding Club : Christmas Party.
Dec.	12.	R.Ae.S. (Belfast) : "Boundary Layers at High Speeds," by Prof. A. D. Young, M.A., A.F.R.Ae.S.
Dec.	13.	R.Ae.S. (Preston) : "Rocket Propulsion and Interplanetary Flight," by A. V. Cleaver, A.R.Ae.S.
Dec.	13.	R.Ae.S. (Weybridge) : "Designing for High Speed," by Professor E. J. Richards, M.A., B.Sc., F.R.Ae.S.
Dec.	13.	Herts and Essex Aero Club : Annual Dinner and Dance.
Dec.	14.	R.Ae.S. : "Clear-air Turbulence over Europe" by Dr. G. S. Hislop, B.Sc., A.R.T.C., A.F.R.Ae.S.
Dec.	14.	R.Ae.C. : Film Show, Londonderry House.
Dec	22.	West Riding Aviation Centre : Annual Dinner and Dance.
Dec.	29.	R.Ae.S. (Weybridge) : Annual Dance.
Jan.	10.	R.Ae.S. (Brough) : "Problems of High-speed Flight," by H. Davies, M.Sc., F.R.Ae.S.
Jan.	10.	R.Ae.S. (Weybridge) : "High-speed Flying," by S/L. J. D. Derry, D.F.C.
Jan.	16.	R.Ae.S. (Belfast) : "Landing Gear and Equipment," by H. G. Conway, M.A., F.R.Ae.S.
Jan.	17.	R.Ae.S. (Preston) : "Aircraft Materials," by Dr. H. Sutton, D.Sc., F.R.Ae.S.
Jan	31.	R.Ae.S. (Weybridge) : "Life and Work of S. F. Cody," by G. A. Broomfield.
Feb.	12.	Institute of Transport : Brancker Memorial Lecture—"Economic Aspects of Airline Operation," by Peter G. Masefield, M.A. (Eng.), F.R.Ae.S., A.F.Inst.A.E., G.Inst.Mech.E., M.Inst.T.
Feb	14	R.Ae.S. (Brough) : "Aero Engines," by A. Cdre. F. R. Banks, C.B., O.B.E.

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SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

Training in Canada

SPEAKING at R.A.F. Station Locking on November 30th, the Secretary of State for Air, Mr. Arthur Henderson, announced that the first 25 pilots to be sent for flying training to Canada in January would all be National Servicemen and would have the acting rank of probationary pilot officer under the new scheme for commissioning pilots and navigators. Subsequent drafts would consist of Regular and National Service pilots and navigators.

The pilots going in January would be flown to Canada and would be trained at Gimli, near Winnipeg. They began their service in October, would have completed their initial training school course in this country, and would spend less than a year in Canada where they would be trained by the R.C.A.F. to "wings" standard. On their return they would be trained at advanced flying schools, many of them on jet aircraft, and at operational conversion units. Navigators to be trained in Canada would go to a flying training school at Summerside, Prince Edward Island.

R.A.F. Squash Rackets

FOR the fourth time, G/C. B. K. Burnett, the holder, has won the R.A.F. Championship. At the Lansdowne Club on December 2nd, he beat W/C. C. H. Beamish, 9—0, 9—4, 9—7.

AIR MARSHAL SIR THOMAS WILLIAMS (right), the C.-in-C., B.A.F.O., was recently presented with the American Distinguished Service Medal for his contribution to the Berlin Air Lift. The presentation was made by General John K. Cannon, commander of the U.S. Air Forces in Germany. Both officers are leaving Germany shortly to take up new appointments. Sir Thomas becomes A.O.C.-in-C., Home Command on March 15th, 1951.

FENCED: This new air-to-air view of the Hawker P.1081 shows that the swept-back wings now bear boundary layer "fences" to offset tip-stalling tendencies. Australia has adopted this Nene-powered interceptor for home defence; production will take place in the Commonwealth.

The W.R.A.F. Championship final was also played off at the Lansdowne Club on Saturday, and Squadron Officer M. M. Sturge retained her title by beating Flight Officer J. M. Pawson, 9—5, 9—3, 9—7.

At Sandhurst, on the same day, the R.A.F. College, Cranwell, beat the Royal Military Academy by three matches to two.

Next I.D.C. Course

THE R.A.F. and Commonwealth Air Force officers selected for the 1951 course at the Imperial Defence College will spend the first week of January at the Air Ministry so that they may be brought up to date in the current problems and policy of the R.A.F. before they begin their year's study at the College.

The week's programme at the Air Ministry will include talks by members of the Air Council and their staffs, and will conclude with a talk by the Chief of the Air Staff, Marshal of the R.A.F. Sir John Slessor.

Officers selected for the course are Air Commodores C. E. Chilton, H. P. Fraser, J. G. Franks and W. L. Freebody, and Group Captains A. G. Adnams, E. C. Bates, D. W. Lane, H. L. Maxwell and K. J. McIntyre.

C.A.S. to Present Cooper Trophy

ON Sunday, December 10th, Marshal of the R.A.F. Sir John Slessor will present the Cooper Trophy to No. 600 (City of London) Squadron, R.Aux.A.F., at Biggin Hill. The Trophy is awarded annually to the winners of a handicap race open to all Auxiliary fighter squadrons; the winner of the 1950 race, held during the R.A.F. display on July 7th, was F/O. K. N. Haselwood of 600 Squadron. Flying a Meteor 4, he averaged 511 m.p.h. over two laps of the 35-mile five-sided course. The two previous holders of the Trophy were Nos. 601 and 502 Squadrons.

Those present at the presentation ceremony will include Air Marshal Sir Basil Embry, A.V-M. T. G. Pike and W/C. Geoffrey Cooper, M.P., the donor of the Trophy. S/L. J. P. Meadows, D.F.C., commands No. 600 Squadron, whose Honorary Air Commodore is H.M. the Queen.

Most Efficient University Squadron

THE Hack Trophy, awarded annually to the most efficient university air squadron, has been won this year by Queen's University Air Squadron, Belfast. In competition with 13 other universities, Queen's scored 1,386 marks out of a possible 1,600—86.6 per cent. Edinburgh U.A.S. was second with 82.9 per cent, and Cambridge U.A.S. third with 80.8 per cent. Other squadrons taking part in the competition were placed as follows: Birmingham (76.0), Durham (76.8), Leeds (71.7), London (77.6), Manchester (70.25), Nottingham (69.68), Oxford (79.0), Southampton (77.4), Aberdeen (74.1), Glasgow (72.7), St. Andrews (71.9).

First awarded in 1942, the Trophy is a gold cup presented by W/C. E. J. Hack. Competition consists of written examinations and flying tests between cadets chosen to represent their squadrons.

B.A.F.O.'s Contribution

IN acknowledgment of a cheque for £427, representing the contribution made to the Lord Mayor's National Thanksgiving Fund by the British Air Forces of Occupation in the British Zone of Germany, Austria and Berlin, the Lord Mayor of London has sent a letter of thanks to Air Marshal Sir Thomas Williams, Commander-in-Chief, B.A.F.O. The B.A.F.O. cam-

SERVICE AVIATION . . .

paign in aid of the Fund was launched in April. More than 20 individuals on various R.A.F. Stations in Germany and Austria, men and women officers and padres, volunteered to act as spare-time collectors on an inter-station competitive basis. Most of them placed collecting boxes in Messes, clubs and canteens; others organized dances and competitions, collections in offices and among married quarters. On one small unit, which did remarkably well, dart players in the sergeants' mess voluntarily fined themselves on the spot for scores of 11 or under.

For the Fastnet Race

YACHTSMEN from B.A.F.O. intend to enter for next year's Fastnet race, the longest and most important British ocean race, which usually takes place in August. The crew will be drawn from R.A.F. yachtsmen in Germany who are members of the various British Sailing Clubs. They will use one of the boats allotted to B.A.F.O. and based at present at Kiel.

Halton C.O. for Middle East

AIR COMMODORE NORTH CARTER, C.B., D.F.C., Commanding Officer of No. 1 School of Technical Training, the R.A.F. Apprentices' School, at R.A.F. Station, Halton, Bucks, since February, 1949, has been appointed Senior Air Staff Officer, No. 205 Group, Middle East Air Force, where he will begin duty towards the end of January. Air Commodore J. G. Elton, at present Chairman of the Air Advisory Committee to the Western Union Military Staff Committee, will succeed him as Commanding Officer of No. 1 School of Technical Training on January 22.

Before going to Halton, Air Commodore Carter was at the Air Ministry, as Director of Administrative Plans from April, 1946, and afterwards as Director of Organization (Forecasting and Planning) from November, 1947. At the outbreak of the war Air Commodore Carter was in the Directorate of War Organization at the Air Ministry. In 1941, as acting Group Captain, he commanded R.A.F. Station, Dalcross. Subsequently he commanded No. 3 Service Flying Training School at South Cerney, Gloucestershire, and R.A.F. Station, Pocklington, Yorks, before returning to the Air Ministry in 1944 as Deputy Director of Bomber Operations. In 1945-46 he was Station Commander at Castel Benito.

Until he took up his present appointment two years ago, Air Commodore Elton was a Deputy Director of Operational Requirements at the Air Ministry, where he went after taking the 1947 course at the Imperial Defence College.

The new Malayan uniform referred to below.

Walking Out—Malaya Style

A PICTURESQUE feature of the walking-out dress approved for the Royal Air Force Regiment (Malaya) is a sarong of light blue interwoven cloth, with a vertical panel, worn to the rear, in the Royal Air Force colours of maroon, light blue and dark blue. The sarong, 36 inches deep, is worn from the waist to a little below the knees over white poplin long trousers made in the Malay style. The walking-out dress is completed by a white poplin shirt in Malay style and a blue-black velvet Malay cap, known as a songkok, on the front of which is worn the R.A.F. airman's badge. Ultimately it is intended that the shirt and trousers shall be made of silk, but the present cost of the material makes this impracticable for the time being.

No. 22 Group Handicrafts

OFFICERS, airmen and airwomen from 26 R.A.F. Stations and units will compete in a handicrafts exhibition arranged by No. 22 Group, Technical Training Command, to be held at Group Headquarters, Market Drayton, on Friday, December 8. The 16 competitive classes are open to both R.A.F. and W.R.A.F. personnel. This will be the second exhibition of its kind to be held by the Group. Among the units competing will be the Schools of Recruit Training at Henlow, Kirkham, Weeton, Melksham, Cosford and Innsworth, and the Administrative Apprentices' Training School at St. Athan, Glamorgan.

The de Putron Trophy

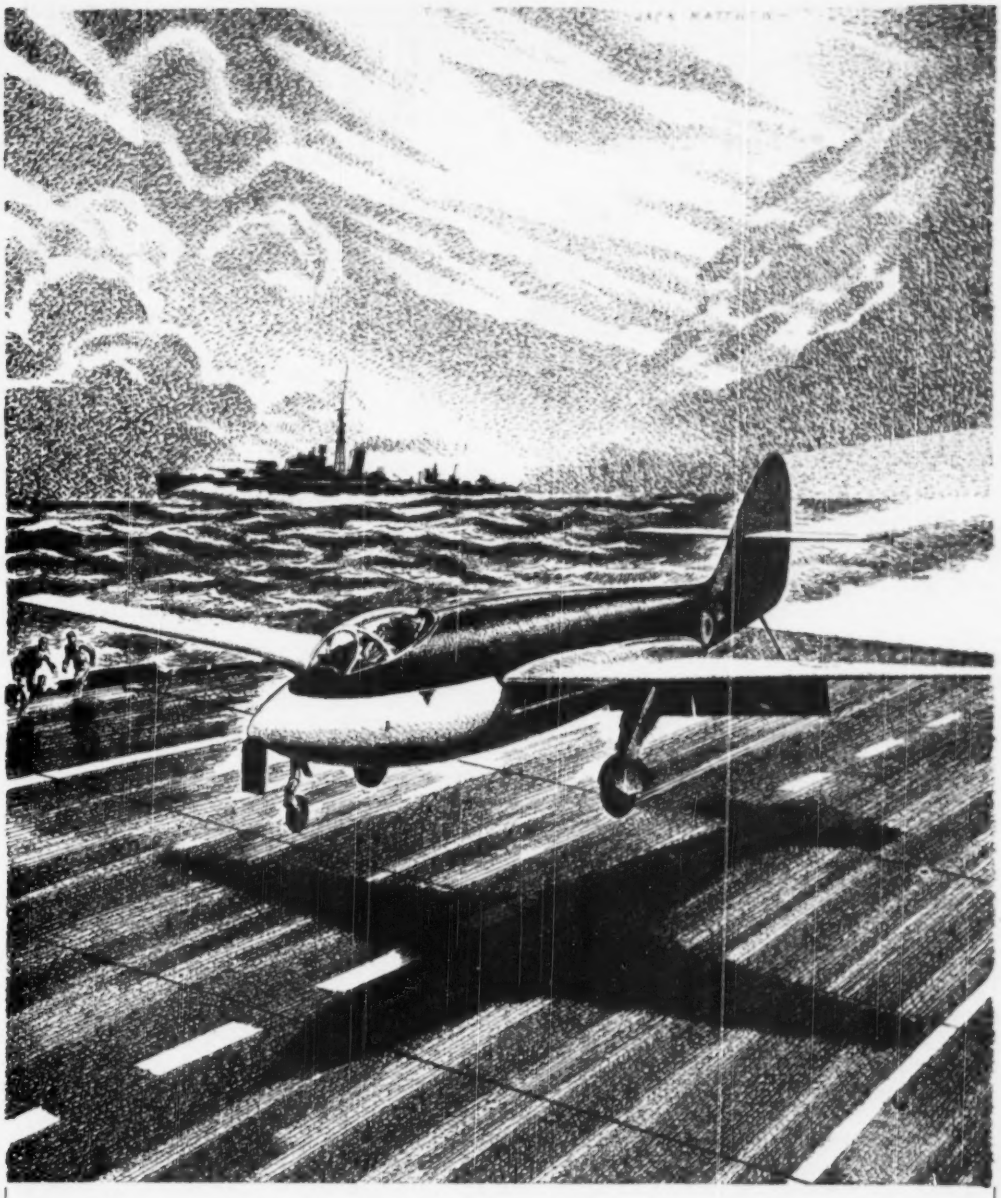
IN 1948 the Provost Marshal and Chief of Air Force Police, Air Commodore O. W. de Putron, C.B.E., A.D.C., presented a trophy—named after him—for competition between the R.A.F. Police Flights. The trophy is a tall silver cup, with a lid on which stands the figure of a R.A.F. policeman cast in silver. Last year W/C. T. P. Worthing, No. 5 R.A.F. Police District, London, won the trophy with No. 137 R.A.F. Police Flight under the command of Flight Lieutenant B. W. Green. This year the trophy has crossed the Channel to B.A.F.O., Wing Commander Roberts having won it with No. 105 Flight at R.A.F. Station, Luneburg, under the command of F/L. Laing.

The Flights are judged for police efficiency, turn-out, drill, kit, maintenance of records and the cleanliness and general appearance of the accommodation. The competition this year was extremely keen, as will be seen from the results, which were as follows: 1st, No. 105 Flight, B.A.F.O. (Luneburg), 83%; 2nd, No. 137 Flight, 5 District (Ruislip, Middlesex), 81.1%; 3rd, Nos. 64/65 Flights, F.E.A.F. (Singapore), 80%; 4th, No. 110 Flight, B.A.F.O. (Gutersloh), 78.8%; 5th, No. 121 Flight, 1 District (Turnhouse, Edinburgh), 78.6%; 6th, No. 134 Flight, 4 District (Duxford, Cambs), 78.4%; 7th, No. 132 Flight, 3 District (Hucknall, Notts), 76.3%; 8th, No. 125 Flight, 2 District (Fazakerley, Liverpool), 70%.

Although originally it was the intention of the Provost Marshal to confine the trophy to R.A.F. Police Flights in Europe, he has included in his 1950 inspection the Flights inspected in the Far East Air Force, which were of an exceptionally high standard.

"Flight" photograph

LONDON AUXILIARIES: These pilots of No. 601 (County of London) Squadron, which is equipped with Vampire 3s and operates from North Weald, are (left to right): F.O. R. G. Large, D.F.C.; F.O. M. Creighton; F.O. R. S. Clark; Sgt. Plt. F. Winch; F.L. C. C. McCarthy-Jones; S.L. P. H. M. Richey, D.F.C. (Commanding Officer); F.L. H. W. B. Patterson; F.O. J. Hardie; F.S. Plt. J. Evans; F.O. A. M. Charlesworth, D.F.C.; F.O. H. J. S. Harmer, D.F.C.; F.O. R. S. Wambeek, D. F. C.; F.O. P. R. Edelston.



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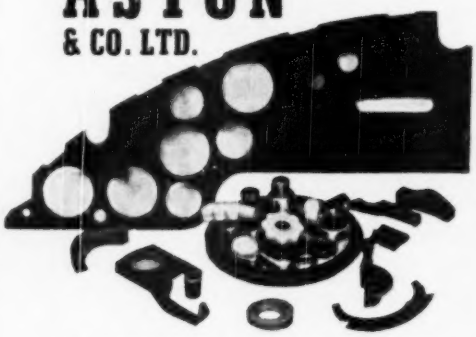

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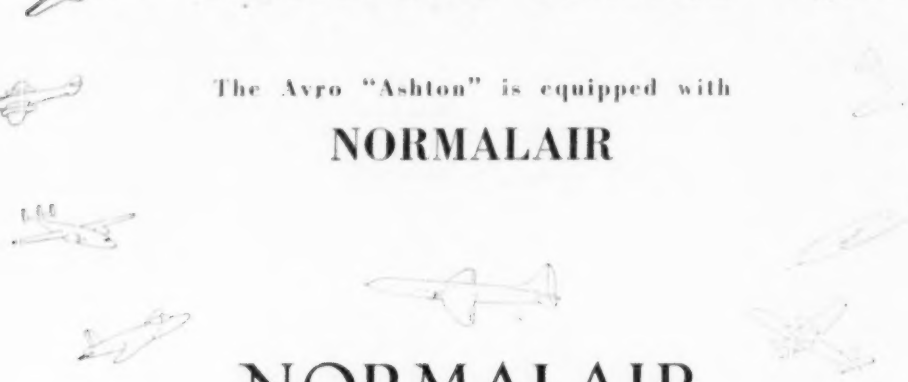

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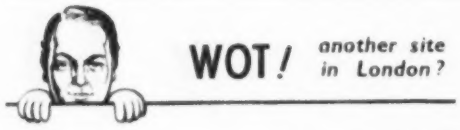

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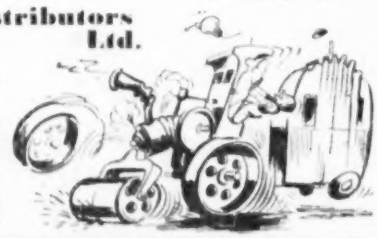

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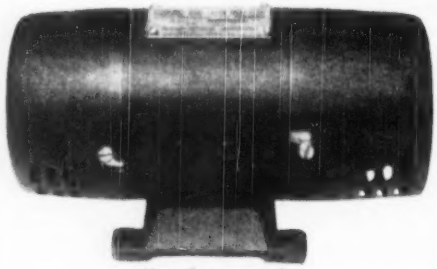

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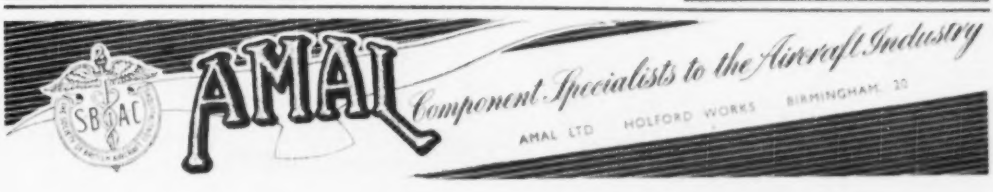

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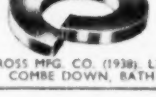

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VACANCIES exist in Nigeria for Meteorologists for the West African Meteorological Service; duties involve responsibility for matters connected with climatology, meteorological research, forecasting for aviation, shipping or agriculture, administration and training of staff; the posts are permanent and pensionable after a period of probation; basic salary, at a point according to qualifications and experience, in the scale £510 (for 5 years) to £1,000, plus overseas expatriation allowance between £150 and £300; temporary non-pensionable Cost of Living Allowance equivalent to 10% of basic salary is also payable; where Government quarters are provided, a rental of between £60 and £90 is deducted according to salary; free first-class passages are provided for officer and his wife once each way each tour of service, and in addition an officer may be granted in any one tour either the actual cost of one return passage for each of two children under the age of 16, subject to a maximum of £75 in respect of each child or an allowance at the rate of £75 a year for each of two children under the age of 16 providing they are maintained outside Nigeria; income tax is at local rates, which are very much lower than those in the United Kingdom; tour of service 18 months; leave on full salary is granted at the rate of 7 days for each completed month of resident service; candidates must normally be under 40 and possess a 1st or 2nd class Honours degree in Mathematics or Physics; experience in aviation forecasting is desirable but not essential; they should write for a form of application to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith St., S.W.1, giving brief details of age, qualifications and experience, quoting the reference number 27116/4. [5624

RADIO Officers required, preferably with first-class P.M.G.

APPLY in writing: Eagle Aviation, Ltd., Luton Airport, Beds. [5616

APPLICATIONS are invited for the following positions in the London area:—

RESEARCH and Development Engineers: Metallurgists; Physicists; Chemists. Senior Electrical Designers.

REQUIRED by manufacturers of A.C. and D.C. electrical equipment for aircraft; applicants should hold at least a Higher National Certificate, or preferably an Engineering Degree; the positions are supernumerated and give considerable scope to ambitious men with adequate experience.—Write, giving full details in strictest confidence, to Box 7424. [5634

AIRCRAFT fitsmen (senior) required; sound experience in similar capacity essential.—Applications in writing, stating age, experience and salary required to Personnel Manager, Percival Aircraft Ltd., The Airport, Luton, Beds. [0515

SITUATIONS VACANT

HANDLEY PAGE, Ltd., have vacancies for technical staff in the following capacities:—

AERODYNAMICISTS, with 1st or 2nd class Hons. Degree and preferably with a minimum of 3 years' experience.

STRESSMEN, with 1st or 2nd class degree or H.N.C. in aeronautical subjects and a minimum of 3 years' experience in aircraft stress analysis.

SENIOR design draughtsmen for Cricklewood and Radlett offices, preferably with aircraft experience; consideration will be given to applicants with experience in light structural or mechanical engineering, possession of Ordinary or Higher National Certificate (Mech. or Elect.) an advantage.—Applications, stating age, qualifications and details of experience to Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [5590

GOOD senior draughtsman required for interesting programme of new work. Apply in the first instance to the Chief Engineer, Percival Aircraft, Ltd., The Airport, Luton. [0503

DRAUGHTSMAN with aircraft experience required for interesting work on small mechanical components; write, stating age, experience and salary required to—Box 7193. [5593

SENIOR draughtsmen required for aircraft work; previous aircraft experience desirable; pension and life assurance scheme.—Apply to Vickers-Armstrongs, Ltd., Weybridge Works, Weybridge. [5510

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with continued design and performance experience for work on both reciprocating and gas turbine aero engines.

APPLICATIONS should state full particulars of experience and qualifications and should be addressed to The Personnel Manager, The de Havilland Engine Co., Ltd., Stonegrave, Edgware, Middx. [0575

BRITISH MESSIER, Ltd., require young stressmen, preferably with experience on structural rig work; please write to—Mr. E. O. Collinson, Chief Technician, British Messier, Ltd., Cheltenham Rd East, Gloucester. [5561

AIRCRAFT estimator required, good all-round experience and ability to work from drawings essential.—Applications in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0594

SERVO Engineers for experimental work are required by a prominent Aircraft concern; applicants preferably under 35 years of age must be educated technically to degree standard, and have experience in the design of one or more of the following:—

HYDRAULIC systems, Servo amplifiers, small electrical mechanisms.

APPLY stating age, experience and salary required, to Box 6841. [5526

INSTRUCTOR required for technical training of flight engineers and pilots to licensed standards; previous experience of lecturing on latest medium large commercial or service aircraft essential; apply giving full details, types of aircraft covered, and salary expected to—Box 7360. [5617

AERODYNAMICIST (male) required, degree in mathematics or engineering, and several years' practical experience in aerodynamic section essential; applications in writing stating age, experience and salary required, to—Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [0592

DRAUGHTSMAN, experienced aircraft or automobile design, salary according to A.E.S.D. rates permanent, progressive positions, good working conditions, 5-day week, single lodging accommodation available.—Apply, Personnel Manager, Lockheed Hydraulic Brake Co., Ltd., Leamington Spa. [5614

TEST Engineers required for development work on aircraft hydraulic systems, previous experience essential, age 21-35, apply in writing stating age, experience and salary required or by telephone to—Mr. R. T. Sewell, Chief Test Engineer, British Messier, Ltd., Gloucester. Tel. Churchdown 5251. [5567

APPLICATIONS are invited from senior and intermediate design draughtsmen, experience of aero engine design desirable but not essential, please write, stating age and giving details of previous experience in chronological order, to—The Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0469

SENIOR Estimator required by large engineering company in eastern suburbs of London, applicants must have practical training and experience of planning and estimating in light electrical engineering; applicants with experience of aircraft wiring will be preferred; state full particulars including age and salary required to—Box 7358. [5615

THE DE HAVILLAND AIRCRAFT Co., Ltd. have vacancies for senior design and intermediate draughtsmen (preferably with aircraft experience) in Chertsey, Surrey and London (Regent Street) offices; applications stating age, experience and salary required, to—Chief Draughtsman, de Havilland Aircraft Co., Ltd., Hatfield, Herts. [5564

DESIGN draughtsmen with H.N.C. in mechanical engineering or equivalent and also detail draughtsmen are required for work in connection with the development of gas turbine engines, previous experience in this class of work is desirable, the positions are permanent and offer good prospects for advancement, the vacancies are at our factory in Burnley, Lancs., but applications quoting age, qualifications and experience should be made to Personnel Manager, Joseph Lucas, Ltd., Great King St., Birmingham. [5625

SENIOR Jig and Tool Designers required by well-known South Midland manufacturers of automobile and aircraft accessories; applicants should have Higher National Certificate or equivalent as well as good technical or production shop experience; wide variety of work of interest to men with initiative; good working conditions, modern canteen, medical and sports and social activities, single lodging accommodation available, apply stating age, salary required and giving a detail of technical and practical experience in chronological order to—Box 7351. [5615

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SITUATIONS VACANT

FITTERS required, preferably with Merlin experience. Apply Fairflight, Ltd., Blackbushe Airport, Camberley 1600. [5625

NAVIGATION Instructors required, Reserve School, Midland area, 2nd N minimum qualification. Write Box 7361. [5630

VACANCIES for four senior draughtsmen, must have had design experience, airframe and equipment.—Apply writing, Chief Designer, Hellaells, Ltd., Walsall Airport. [0704

HANDLEY PAGE, Ltd., have a vacancy for a technical author for work in connection with the preparation of maintenance manuals, pilots notes, technical specifications, etc., previous experience in this type of work preferable.—Write stating age and full details of experience to Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [5622

SENIOR Technician required for aircraft airworthiness department, applicants should have had a minimum of 5 years' technical experience of aircraft structures with preferably some additional experience of aerodynamics performance and airworthiness requirements, a senior staff appointment and excellent prospects of advancement.—Apply Box 6891. [5539

SENIOR aerodynamicist required for work on high-performance aircraft; applicants should have an engineering degree and experience in design of controls, performance calculations and estimation of aerodynamic loads.—Write giving particulars of age, experience, and salary required, to the Employment Manager, Vickers-Armstrongs, Ltd., Weybridge Works, Weybridge. [5509

HANDLEY PAGE (READING), Ltd., have vacancies in their design office for stressmen who should have at least two years' experience and with qualifications up to A.F.R., Ae.S. or B.Sc. standard; these vacancies carry excellent prospects for the right men.—Send full particulars to the Personnel Officer, Handley Page (Reading) Ltd., The Aerodrome, Woodley, Reading. [0574

VACANCIES exist at Blackbushe Airport for one welder/sheet metal worker and one electrician.—Applications to Manager, Silver City Airways, Ltd. [5610

INSTALLATION engineers required for electrical apparatus on aircraft, applicants should have had practical experience with both electrical and mechanical aircraft instruments, and be prepared to work irregular hours away from base; some electronic knowledge is also essential.—Apply, stating experience and salary required, to Smiths Aircraft Instruments, Ltd. (Ref. SAI/7857), Cricklewood Works, London N.W.2. [5635

SENIOR aircraft draughtsmen are required by the English Electric Company, Ltd., for employment at Warton Aerodrome near Blackpool; suitably qualified applicants will be employed on new design work or modifications and experienced aircraft draughtsmen are invited to apply for these vacancies mentioning reference 120C to Central Personnel Services, English Electric Company, Ltd., 24/30, Gillingham St., London, S.W.1. [5558

THE BRISTOL AEROPLANE Co., Ltd., have vacancies in their London and Bristol Design Offices for Senior and Intermediate Draughtsmen with aircraft or general light engineering experience, preferably with Higher National Certificate or equivalent qualifications.—Applications, stating age, qualifications and previous experience should be addressed to The Personnel Manager, The Bristol Aeroplane Co., Ltd., Aircraft Division, Filton House, Bristol. [5538

GIBRALTAR AIRWAYS, Ltd., invite applications for the post of station engineer based at Gibraltar, essential qualifications: "A" licence coverage for Rapide airframes and "C" licence for Gypsy Queen III engines, Viking and Hercules 650 series endorsement an advantage, salary including cost of living allowances approximately £850 per annum.—Write to Personnel Officer, Overseas Staff, British European Airways, Kerline House, Ruislip, Middlesex. [5632

WEIGHTS estimator required; must have aircraft drawing or design experience. South Coast area; hostel accommodation; Superannuation Scheme.—Write Box 7425. [5636

SITUATIONS WANTED

PILOT, B licence, radio, desires post; travel anywhere.—Moore, c/o Fire Station, South Brisbane, Australia. [5621

CHARTERED electrical engineer (37), installation, development and sales with reputable firms; 10 years aircraft electrics.—Box 7357. [5612

RADIO Navigator, holding first-class radio and navigation licences, requires employment, preferably as Flight Navigator, 2,500 hours, free end December.—Box 7371. [5631

AIRCRAFT Maintenance Engineer, with considerable administrative and executive experience, seeks change of position; mechanical engineering degree; maintenance engineer's Licences A, B, C, D and X covering a large number of British and American types including Skymasters, etc.; commercial pilot's licence; R/T certificate, A.F.R.Ae.S.—Write, "Aeroplane," c/o Central News Agency, Ltd., Benoni, South Africa. [5618

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TEST stands for magnetos, generators and starter motors, preferably of American manufacture.—Vendair, Croydon Airport, Croydon 5777. [0808

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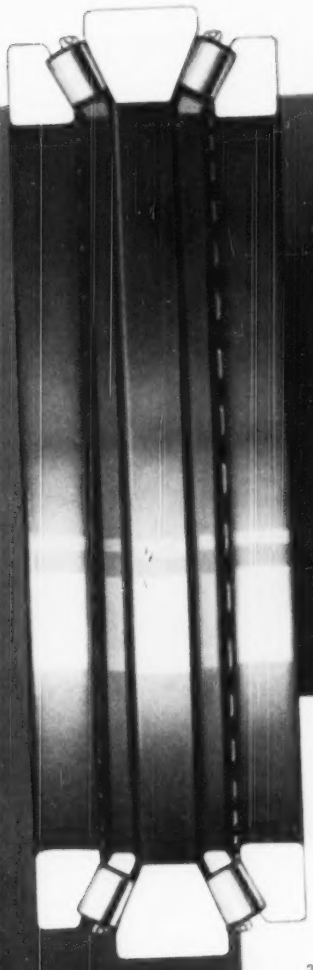

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